GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

# ECONOMIC IMPACT OF FUTURE OFFSHORE PETROLEUM EXPLORATION

## JOINT REPORT


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GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

# ECONOMIC IMPACT

# OF

# FUTURE OFFSHORE PETROLEUM EXPLORATION ACTIVITIES

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## Acknowledgements

This report was undertaken as a joint effort between the Petroleum Directorate and the Department of Development. The project was carried out under the direction of Dr. Pedro Van Meurs and Mr. Peter Furlong. Members of the project team included Messers. John Collins, Lorne Spracklin, Barry Rodgers, William Smith, David Hawkins, and James Davidson. The computer work was carried out by Mr. James Wyse of Wyse and Associates and by Mr. James Cardwell of Newfoundland and Labrador Computer Services Limited. Typing was done by Miss Judy Ryall and Miss Cynthia Roche and editing by Dr. Rex Gibbons.

PETROLEUM DIRECTORATE, ST. JOHN'S, NEWFOUNDLAND MAY, 1981

## Foreword

The economic impact of the petroleum industry upon the province's economy is of vital concern. Offshore oil and gas exploration, development and production activities are new to the province and are superimposed upon an economic structure which is somewhat fragile. Moreover, the uncertainties are great and there is little information and data pertaining to the economic aspects of these activities and their likely effects upon the provincial economy. This report on the economic impact of future exploration activities on the economy of Newfoundland and Labrador is the first in a series of reports dealing with the impact of the offshore petroleum industry on the province.

It cannot be emphasized too strongly that the forecasts provided here are just that, forecasts, and should not be treated as the definitive and final word on the subject. There are a wide variety of things that could happen, literally overnight, which would cause the forecasts given here to change drastically. The international petroleum industry will always be very uncertain, and this uncertainty applies particularly to the exploration phase. Nevertheless, even with all of its uncertainties, forecasting is a necessary prerequisite to sound policy decisions. The forecasts provided here and those to be provided in forthcoming studies are even more vital because of the large scale of potential developments compared to the local economy and the complexities of the decisions to be made.

This report presents forecasts of the number of exploratory wells expected to be drilled over the 10-year forecast period based on a review of the geology of the area. Using these well forecasts, the report provides an impact forecast in terms of goods and services required by major impact item and in terms of an employment forecast by major employment category. Total expenditures on exploration over the forecast period are also discussed and analyzed. The report then discusses the current state of the provincial share of these expenditures, and a final section discusses the possible future share accruing to the provincial economy as a result of the implementation of provincial policies.

It is hoped that this report and the others to follow, will provide a timely and useful framework for planning and decision making in government and the community as a whole. The Petroleum Directorate and the Department of Development welcome comment on the forecasting methodology and the substance of this report.

Steven M. Millan
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## Summary & Conclusions

The purpose of this paper is to report on the potential direct economic impact of oil and gas exploration offshore Newfoundland and Labrador, 1981-1990. The analysis concentrates on the exploration phase only and does not include the impact of delineation, development or production phases which will be the subjects of later reports.

The forecast of economic impact is based upon the forecast of the number of exploratory wells to be drilled over the 10-year forecast period. Three levels of exploration activity are forecasted, labelled FEP (federal energy program), low and high. The FEP forecast is, in effect, the low forecast adjusted downwards to represent the reduced attractiveness of exploration caused by the federal energy policy. Under the FEP case, a total of 63 wells are forecasted. Under the low case, a total of 154 are forecasted while under the high case a total of 279 wells are forecasted.

Based upon the anticipated number of wells forecast to be drilled the report provides detailed information of the quantities of goods and services by major expenditure item, manpower requirements by major employment category and total cost in terms of resulting wages and salaries and expenditures on goods and services for each of the FEP, low and high forecasts. Total employment ranges from an annual low of 472 manyears under the FEP forecast to an annual high of 2,859 manyears under the high forecast. Associated wages and salaries range from an annual low of $ 16 million to an annual high of $ 102 million in constant 1981 dollars. Total expenditures range from an annual low of $ 193 million to an annual high of $ 1,434 million constant 1981 dollars.

Not all the activity taking place in the offshore area will affect the provincial economy. Many expenditures will have no local impact, while others will be totally local. At present, income to local residents of the province from employment in exploration constitutes the largest percentage contribution to the total direct impact resulting from offshore exploration. (In fact, to now , the impact of employment in exploration has been greater than all other benefits flowing to the province combined). The participation of total labor directly employed in offshore exploration activity is already high for many categories ranging from 55% to 71%. By the end of the forecast period, the participation rate of residents in the labor force is expected to be 90% to 95% for most categories.

Depending upon the outcome of the various factors, it is clear that the direct impact could vary considerably. Estimates of the range of the possible provincial share is given, therefore, in terms of a low, medium and high. If we combine this low, medium and high range of possible outcomes with the forecast of exploration activity, namely, FEP, low and high, we get nine different scenarios.

The following table summarizes the direct economic impact of exploration on the provincial economy for 1990 under the nine scenarios

analyzed. The table shows that the direct impact of exploration on the province in the year 1990 could range from $22 million (FEP-Low scenario) to $294 million (High-High scenario). The direct impact of exploration on the province in 1981 is estimated at $ 36 million. This underlines the high level of uncertainty associated with this forecast.

Summary of Direct Impact, 1990
($ Millions Cdn. 1981)

| Level of Exploration Activity | Direct Impact Range | | |
|---|---|---|---|
| | Low | Medium | High |
| FEP | | | |
| Wages and Salaries | 12 | 13 | 14 |
| Other Benefits | 10 | 16 | 27 |
| Total | 22 | 29 | 41 |
| Low | | | |
| Wages and Salaries | 37 | 41 | 46 |
| Other Benefits | 37 | 59 | 99 |
| Total | 74 | 100 | 145 |
| High | | | |
| Wages and Salaries | 73 | 82 | 92 |
| Other Benefits | 76 | 121 | 202 |
| Total | 149 | 203 | 294 |

There are several important conclusions that may be drawn from this analysis of the direct economic impact of exploration on the province.

The first conclusion to be drawn from the analysis is that exploration alone, independent of development, has the potential to have significant impact on the provincial economy and under the high forecast would approach that of the development phase. Total expenditure on exploration over the 10-year forecast period ranges from $ 2.4 billion to a little under $ 10.0 billion ($ 1981). The current estimate for Hibernia development is in the range of $ 5 billion to $ 7 billion ($ 1981).

The second conclusion to be drawn from the analysis is that the ultimate level of impact of the exploration on the province is to a large degree determined by the level of exploration and to a lesser degree by the success of the province to participate in the operations.

If the federal energy policy is maintained, the actual level of exploration attained will be represented by the FEP forecast.

Therefore, the level of economic activity in the province as a result of exploration will decrease substantially unless the province succeeds in providing a significantly higher percentage of goods and services than at present (the FEP - high senario). Even if the province were successful in increasing its participation in supplying goods and services, then, the total impact would only improve marginally from $36 million in 1981 to $41 million in 1990. It is, therefore, crucial that the province continue its opposition to most of the FEP in order to persuade the federal government to improve conditions for exploration off Canada's East Coast.

If the federal government were to soften its stand, the low-high scenario could be realized thereby resulting in a four-fold increase in the level of exploration related impacts on the province to approximately $145 million by 1990.

Another important conclusion that can be drawn from this report is that the provincial government has been very successful in enforcing a high provincial share in the direct employment generated by the petroleum industry. Policies, of course, should continue to be directed at improving this share even further. Referring to the above table, even under optimal conditions (the low-high scenario) the provincial direct employment can only be expected to increase from $19 million in 1981 to $46 million in 1990. A significant improvement, however, can be made in providing goods and services which could be increased from $17 million to $99 million by 1990 (assuming the low-high forecast). This would be an increase of approximately 600% over the present situation. Such an increase would result in a significant increase in indirect employment. (It should be repeated here that indirect employment, has not been forecasted in this report, but will be analyzed in detail in later publications). In view of the fact that the direct employment measures have been relatively successful and have gradually reached a saturation point, government policy emphasis should shift more to the indirect employment which could be generated by increasing goods and services provided from within the province. The current strengthening of the Offshore Services Unit in the Department of Development is an important element in this shift in emphasis.

Finally, this report clearly indicates that a large number of drilling rigs and supply boats will be required during the next decade in the provincial offshore even under negative assumptions on the impact of the recent federal energy policy. Local ownership of some of these rigs and supply boats would greatly enhance the benefits that the province would obtain from the offshore. In order to investigate this matter in more detail the Petroleum Directorate will make an estimate of the requirements for supply boats, rigs, etc. during the period 1981-1990 in relation to all petroleum related drilling in the province including exploratory, delineation, and development drilling.

# 1. Introduction

## 1.1 Purpose of the Report

In 1979, Chevron Standard Limited, drilling on an area issued under permit to Mobil Oil Canada Ltd., discovered the Hibernia field approximately 312 kilometers southeast of St. John's. Since the drilling and subsequent testing of the Hibernia P-15 discovery well, two stepout wells, O-35 and B-08, have been drilled and tested with both yielding positive results. A third stepout well, G-55A, was also drilled, found to be dry, and abandoned. One additional well, K-18, is presently being drilled. At least one other is planned. The estimated recoverable reserves of the Hibernia field now stand at 294 million cubic metres of oil and 57 billion cubic metres of natural gas at the 50% probability level. Overnight the discovery of the Hibernia field has moved Newfoundland and Labrador into the forefront of oil and gas exploration and development in North America and possibly in the world. The questions now being asked are "What will be the impact of oil and gas on Newfoundland and Labrador, its economy, its people and their way of life?", "How can we best prepare ourselves for the future?" and "What policies should be put in place to optimize the benefits and minimize the negative effects?".

The purpose of this paper is to report on an analysis undertaken jointly by the Petroleum Directorate and the Department of Development on the potential direct economic impact of oil and gas exploration offshore Newfoundland and Labrador.

It cannot be emphasized too strongly that this is a first attempt at analyzing what is beyond any question a most complex area. It is hoped, however, that this report will supply useful, albeit preliminary, information on the impact of oil and gas exploration in the province and will provide direction for future work. The present analysis has been concentrated on the exploration phase only and does not include the impact of the delineation, development or production phases, which will be the subjects of later reports.

The next section of this first chapter outlines forthcoming studies to be undertaken by the Petroleum Directorate over the next six months. The third and fourth sections discuss the need for forecasting and the uncertainties associated with it. The fifth section addresses the need for computerized modelling and outlines the methods used to develop the current version of the exploration phase expenditure impact model. The final section gives a brief description of the limitations of the model at its present stage of development.

Chapter 2 of this report provides a description of the forecast of exploration activities on which the economic impact forecast is based. For the purpose of this study, the Newfoundland and Labrador offshore is divided into four areas: the Labrador Shelf, the Northeast Newfoundland Shelf, the Northern Grand Banks and the Southern Grand Banks. A geological overview, the major exploration targets, and the anticipated program for the 10-year period from 1981-1990 are given for each of the four areas.

Chapter 3 deals with the exploration activity offshore Newfoundland and Labrador from a policy point of view. Matters pertaining to the current and possible land position of the Newfoundland permittees and to the exploration policy of the Government of Newfoundland and Labrador are raised and discussed. The chapter concludes with a discussion of the effects of the federal energy policy on the forecast of exploration activities presented in Chapter 2.

Chapter 4 provides forecasts of the economic impact of exploration activity resulting from the geological forecast. The economic impact forecast is discussed in terms of goods and services required by major impact item and in terms of an employment forecast by major employment category. The chapter concludes with a discussion of total expenditures on exploration over the forecast period.

Chapter 5 discusses the current state of the provincial share of expenditures generated by these exploration activities in the offshore. Again, the discussion is in terms of goods and services, employment and total direct impact.

The final chapter discusses the possible future share falling to the provincial economy in light of provincial policy issues.

## 1.2 Outline of Forthcoming Studies

This report on the economic impact of future exploration is the first in a series of economic impact reports and studies being undertaken by the Petroleum Directorate and the Department of Development and forms part of ongoing research in the area of forecasting activities.

The work schedule over the next several months is divided into two parts, (1) forecast of direct effects and (2) forecast of indirect effects. Direct effects relate to the expenditures for goods and services, wages and salaries, and direct payments to governments by the offshore petroleum industry. The expenditures include those for services such as the rental of rigs, supply boats and helicopters as well as related employment costs and payments for materials such as fuels, cement and well casing. Direct payments to governments include royalties, taxes and income to the Newfoundland and Labrador Petroleum Corporation.

The indirect effects, on the other hand, are the effects of the above expenditures and payments on the provincial economy as a whole. For instance, an increase in profits of helicopter companies may lead to the payment of higher corporate income tax in the province or payment of dividends to its residents. The payment of royalties and taxes by the oil companies to the provincial government will lead to significant changes in budgetary policy which in turn will induce profound changes in the provincial economic performance.

The results of the direct effects will be published in four reports:

(1) the direct effects of exploration expenditures (this report);

(2) the direct effects of payments to government (to be published in June, 1981);

(3) the direct effects of development expenditures (to be published during the summer); and

(4) the direct effect of operating expenditures (to be published later in the year).

The reason for dividing the information into four separate reports rather than combining it into one single report is to facilitate the provision of information to the public as soon as it becomes available.

When the work relating to direct effects has been completed , another series of studies will be undertaken and reports published dealing with the indirect economic impact of the petroleum industry on the province's economy. These studies will begin this fall and will be carried out over the fall and early winter.

## 1.3 The Need for Forecasting

The need for forecasting is vital. Decisions have to be made both within and outside government. The people of the province and its government need

to know what to expect from oil and gas exploration, development and production and how to cope with it in order to better mold the opportunities it offers to the best possible advantage.

Offshore petroleum developments will have a profound impact on the economy of Newfoundland and Labrador. In recognition of this fact, the provincial government has provided for a detailed procedure in the Newfoundland and Labrador Petroleum Regulations to enable it to properly manage these impacts. Under these regulations, oil companies will be required to submit to the provincial government a detailed development program before entering the development phase. It is expected that Mobil Oil Canada Ltd., will present such a program for development of the Hibernia field by the end of 1981. This development program will be reviewed openly and with full participation by the public through an independent hearing process. Only after this public hearing process has been completed and reported on will the Minister decide to approve, approve in principle, or reject the program. In addition, the provincial government has also established the Offshore Petroleum Impact Committee (OPIC) to advise it on the many matters relating to the impact of offshore petroleum activities on the province.

In order to properly prepare for the hearing process and to assist the Offshore Petroleum Impact Committee in its work, it is important that there be ample information available pertaining to the offshore petroleum industry and, in particular, the economic aspects of the anticipated developments. This report on the impact of future exploration activities together with the three forthcoming studies on the direct effects of payments to governments, the direct effects of development expenditures and the direct effects of operating expenditures, should considerably bridge the information gap that now exists. The work to be performed later in the year relating to indirect impacts should provide much of the information necessary to facilitate the many decisions that will have to be made. This information flow together with the analytical capabilities built up in the Petroleum Directorate, the Department of Development and other departments and agencies of government will, it is hoped, provide invaluable aid in the hearing process and for the work of the Offshore Petroleum Impact Committee.

It is envisaged also that other departments and agencies of government along with the private sector will take the information presented in this and forthcoming reports by the Petroleum Directorate and use it as the basis for their own studies into more specific matters pertaining to the impact of the offshore petroleum industry.

### 1.4 Uncertainties of Forecasting

Forecasting and impact assessment for a dynamic industry such as offshore oil and gas over a ten-year period are not easy tasks. Petroleum activities will always be uncertain and, therefore, difficult to predict. This uncertainty applies particularly to the exploration phase which for any given area is likely to vary from a state of aggressive exploration to a state of complete inactivity. For example, a single important discovery, Hibernia, changed the entire outlook offshore Newfoundland. Such important discoveries could also occur in other areas of the offshore. Further development of Hibernia will result in much new and unexpected data that could change a company's approach and outlook regarding many areas. Also, worldwide oil market developments and the situation in the Middle East could very quickly and drastically alter the value and the importance of offshore

oil. Plus, in petroleum exploration, it is very difficult to predict what may happen next year, let alone ten years from now. The encouraging results of last year's exploration activity off our coast could be followed by a series of dry holes that could discourage further exploration. On the other hand, important discoveries in entirely new geological areas could result in a flurry of additional activities.

The future of exploration offshore Newfoundland and Labrador during the next ten years is so uncertain that one may ask "Why bother making forecasts at all?". We believe there are at least two reasons why it is important to have such forecasts:

1. There has been exploration offshore Newfoundland and Labrador since 1966, and the subsequent growth of a rather diversified offshore services industry. It is important to assess the future of this industry itself, irrespective of the Hibernia development, and to evaluate what possibilities exist for the expansion of these offshore service industries. Currently, the province captures a small percentage in terms of direct impact from total expenditures on goods and services. An increase in this share could bring significant additional benefits to the province.

2. The impact of future development, such as the Hibernia development, on the province will be in addition to the impact from exploration activities. However, as will be obvious from Chapter 4, under certain assumptions, the total expenditures on exploration could exceed the expenditures on Hibernia development during this decade. The exact impact of Hibernia, therefore, cannot be properly estimated unless the impact from exploration has been determined first.

The forecast of exploration activities, however, is not much more than a description of what may happen under a rather wide but realistic range of possibilities. It may be good to briefly summarize the main reasons for the uncertainty in forecasting the level of exploration.

Geology: The geology of the area offshore Newfoundland and Labrador is still largely unknown. The number of wells per square kilometer is very low in comparison with the North Sea, for example. As a result, it is not yet possible to do forecasting studies on the basis of a large amount of statistical data and the trends of this data. The estimated level of exploration activity is based on opinions of geologists about the relative attractiveness of the various areas. These opinions are still to a large degree subjective in nature.

Technology: It is likely that the technology of exploration - particularly that of deep water drilling - will develop rapidly during the next decade. This may have a major effect on the number of wells that could be drilled.

Economics: Currently, only very large oil or gas fields are economically attractive to explore for, even on the basis of international prices . However, new technology may make smaller fields attractive. Furthermore, drastic changes in international prices may completely alter the attractiveness of east coast exploration. On the other hand, continued strong inflation and even higher rates of interest may make further exploration and development unattractive.

Politics: The current federal energy policy has drastically lowered the attractiveness of oil

and gas development on provincial lands. The continuation of exploration is now, to a large degree, dependent on possible further changes in these policies. Furthermore, the uncertainty over which government will own and administer offshore Newfoundland and Labrador petroleum resources may impede exploration and development in the future.

In view of this large degree of uncertainty, it would be wrong to make a single forecast. Therefore, three forecasts have been prepared - one high and two different low cases. This gives the reader a much better feeling for the margin of uncertainty that must be considered.

It must also be said that even such a large range of possibilities may not represent reality. The assumptions and information upon which the forecasts are made change rapidly and could make the forecasts outdated within a few months. Therefore, the Petroleum Directorate has developed a computerized model by which forecasts and resulting analyses may be adjusted quickly if conditions change. Where necessary, a new publication will be made in order to keep the public and the Offshore Petroleum Impact Committee up to date with the latest information. Furthermore, the Petroleum Directorate and the Department of Development will continue to improve the data base and the computerized models used in the analysis. In this way, future publications should provide improved quality and detail.

The government, through its various agencies, is committed to gathering, analyzing and reporting on the information that is available at any given time. We, therefore, welcome comments and suggestions on the forecasting methodologies used and the substance of this report, and welcome suggestions for improvement.

### 1.5 Description of the Computer-Based Model

As was stated above, a model was developed by the Petroleum Directorate to assist in analysing the economic impact of future exploration activities under alternative scenarios. This model in effect determines direct material demands, expenditure impacts, employment opportunities and the extent to which the province will participate in each. The process of developing this model involved the formulation of a set of relationships linking the activities of an exploration program to these demands, impacts and opportunities. This set of relationships attempts to approximate real world conditions and provides a tool for analysis of the exploration program.

Some of the potential benefits of employing such an analytical framework include:

(1) a consistent approach to analyzing alternative forecasts and synthesizing their impacts;

(2) a means of evaluating the significance of any variable and its interrelationship with, and effect upon, other variables; and

(3) a mechanism for identifying the information to be collected when assessing policy effectiveness.

The additional benefits to be gained from computerizing the model include:

(1) making the large volume of calculations required to synthesize the impacts feasible, and

(2) permitting rapid recalculation when more relevant information becomes available and forecasts change.

The model is supplied information on the forecasted exploration program and related activities. It then invokes a set of relationships which factor in physical, cost, and employment characteristics and parameters. Based upon these relationships, material demands, expenditure levels, employment volumes and the degree of provincial participation are produced.

Formulation of the model, that is, the process of determining the relationships among important variables, was based on an analysis of data from a variety of sources. Information was collected and analyzed for such areas as the North Sea, the Beaufort Sea and from publications issued by groups such as the New England River Basins Commission and the United Kingdom and Norwegian governments. Statistical data from those wells drilled in the Newfoundland and Labrador offshore area over the past 15 years was the primary data source along with invaluable information obtained from discussions with petroleum industry officials and experts.

Once the variables and their interrelationships were identified, the model was subjected to a process whereby its output was audited against actual exploration program data. Based on the results of this audit, refinements and other improvements were made - usually taking the form of new variables being introduced, unimportant variables being eliminated and relationships between variables being changed.

Figure 1 illustrates the exploration phase impact model in perspective with its basis (the forecasts), its results (material requirements, expenditures, etc.) and its process of development (the analysis-formulation-validation cycle).

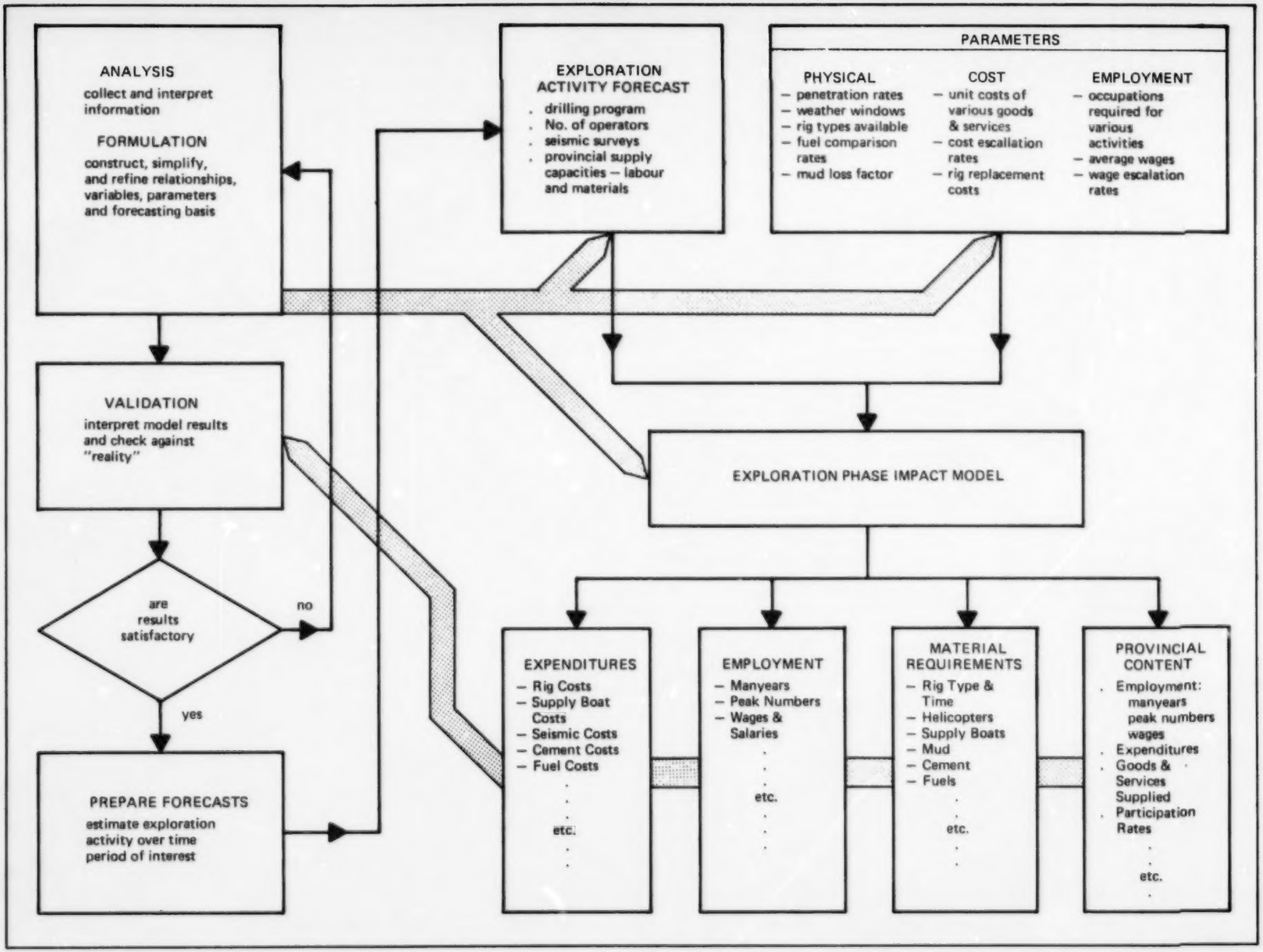
As shown, the development process is an iterative one with information collection and analysis resulting in the formulation and refinement of variables, parameters and relationships which are then implemented in the model. Historical or actual exploration activities were processed by the model and its results were taken and evaluated against known outcomes. Where outcomes did not adequately reflect those of actual cases, then further information was collected and analyzed with reformulations being undertaken.

Figure 1 also notes some examples of the items constituting the exploration forecasts, the physical, cost and employment parameters and the resulting aggregates comprising materials, expenditures, employment and their provincial components.

### 1.6 Limitations of the Model

When attempting to simulate reality there are obvious limitations due to the inherent simplifications that must be made. The model is limited to estimating the goods and services, employment and expenditures related to a certain exploration program.

With regard to the estimation of goods and services (rig rental, supply boats, cement, casing, etc.), the model is believed to be reliable under normal conditions. It has been tested against the actual experience of approximately 70 wells and the model results are close to the actual levels of goods and services needed for any particular well. However, the actual needs for goods and services on a well-by-well basis may be quite different from the forecasted needs. This is because the needs for goods and services vary a great deal around the average expectation. Sometimes, a well could be drilled considerably faster than expected. On the other hand, unforeseen circumstances, such as bad weather conditions, equipment failures etc., could cause significant


ANALYSIS
collect and interpret information
FORMULATION
construct, simplify, and refine relationships, variables, parameters and forecasting basis
EXPLORATION ACTIVITY FORECAST
. drilling program
. No. of operators
. seismic surveys
. provincial supply capacities – labour and materials
PARAMETERS
PHYSICAL
– penetration rates
– weather windows
– rig types available
– fuel comparison rates
– mud loss factor
COST
– unit costs of various goods & services
– cost escallation rates
– rig replacement costs
EMPLOYMENT
– occupations required for various activities
– average wages
– wage escalation rates
VALIDATION
interpret model results and check against "reality"
EXPLORATION PHASE IMPACT MODEL
are results satisfactory
no
yes
PREPARE FORECASTS
estimate exploration activity over time period of interest
EXPENDITURES
– Rig Costs
– Supply Boat Costs
– Seismic Costs
– Cement Costs
– Fuel Costs
etc.
EMPLOYMENT
– Manyears
– Peak Numbers
– Wages & Salaries
etc.
MATERIAL REQUIREMENTS
– Rig Type & Time
– Helicopters
– Supply Boats
– Mud
– Cement
– Fuels
etc.
PROVINCIAL CONTENT
. Employment: manyears peak numbers wages
. Expenditures
. Goods & Services Supplied
. Participation Rates
etc.

delays in the completion of the well.

The employment forecasts are based on an extrapolation of the current actual industry experience. The order of magnitude of the employment figures is believed to be realistic. Further research is required, however, on certain employment classes.

The estimates of total expenditures are also based on an extrapolation of current cost data. Several of these data require more detailed research. However, the order of magnitude of the forecasted levels of expenditures is reasonable.

One important limitation of the model is that it is not interactive. Data are analyzed on an individual basis only, and subsequently aggregated. No efforts have been made to incorporate the possible economies of scale of drilling many wells in the same area, or possible complications of having to suspend and return to a well as a result of ice or weather conditions. A typical example of economies of scale could be the more efficient use of helicopters and supply boats if several wells are being drilled at the same time in the same area. It was felt, however, that in view of the large offshore area and the limited exploration program, these interactive effects would not be very important and would therefore not alter the results in an important way.

## 2. Forecast of Exploration Activities

### 2.1 Introduction

The continental shelf, slope and rise off the east coast of Newfoundland and Labrador comprise an area equal to 1,849,000 square kilometres. Nine companies or groups of companies and the Newfoundland and Labrador Petroleum Corporation hold provincial exploratory permits on this continental margin. These permits cover an area of 236,953 square kilometres. To date, more than 400,000 line kilometres of geophysical data have been collected and processed over the continental margin. At the time of writing, 73 wells have been drilled and 3 are drilling. Four gas/condensate discoveries have been made off Labrador and one major oil discovery on the Grand Banks. Several other wells have had significant hydrocarbon shows.

The continental margin can be broken down into four areas on the basis of geology, as shown in Figure 2. These areas have also been further divided into 10 management zones on the basis of water depth and environmental conditions. These divisions are used in this report to help define the exploration activity forecasts for the offshore Newfoundland and Labrador area.

The forecasts given here are for wildcat exploratory wells only and therefore do not include delineation or development drilling.

Three levels of exploration activity are forecasted. Firstly, the range is given which was contemplated as a reasonable estimate before the new federal energy program (FEP) was established. This range is given as a low and a high estimate. The FEP, however, appears to have drastically reduced the attractiveness of exploration. Therefore, the low estimate has been adjusted downwards to represent the new economic situation. This new low forecast is called the FEP forecast and is based upon the assumption that the negative impact of the FEP will continue into the future. The high forecast now only represents a level of what could be attainable if the federal government were to amend the negative aspect of its present energy policy to the pre-FEP situation. The high forecast also implicitly assumes that a second round of permits is issued by the province. The high forecast under the new federal energy program may approximate the pre-FEP low forecast.

### 2.2 Anticipated Seismic Program

Table 2:1 gives the forecast of line kilometres of seismic to be shot over the 10-year forecast period for each of the four geological regions described in Figure 2. In each case, the FEP, low and high are given to provide a realistic range. The total program is anticipated to amount to between 245,000 to 680,000 line kilometres of seismic over the 10-year period.

It should be noted that the forecast given here for the FEP, low and high represent a range within which the actuals are expected to fall.

### 2.3 Labrador Margin

#### 2.3.1 Geological Overview

The Labrador continental margin comprises an area of approximately 394,000 $km^2$ with water depths generally less than 500m. Basement rocks of the shelf are dominantly Precambrian in age, although some Paleozoic rocks are preserved. Sediments covering these basement rocks are mainly Cretaceous to Tertiary in age and consist for the greater part of sand and shales.

The Lower Cretaceous rocks range

Table 2:1

Forecast of Seismic Program
(1000's Line Kilometres)

| | Lab. Margin | | | Northeast Nfld. | | | N. Grand Banks | | | S. Grand | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | FEP | Low | High | FEP | Low | High | FEP | Low | High | Banks | FEP | Low | High |
| 1981 | 7 | 10 | 14 | 7 | 10 | 14 | 6 | 10 | 12 | - | 20 | 30 | 40 |
| 1982 | 7 | 10 | 14 | 7 | 10 | 14 | 6 | 10 | 12 | - | 20 | 30 | 40 |
| 1983 | 9 | 14 | 21 | 9 | 14 | 21 | 7 | 14 | 18 | - | 25 | 42 | 60 |
| 1984 | 9 | 14 | 21 | 9 | 14 | 21 | 7 | 14 | 18 | - | 25 | 42 | 60 |
| 1985 | 9 | 18 | 28 | 9 | 18 | 28 | 7 | 16 | 24 | - | 25 | 52 | 80 |
| 1986 | 10 | 21 | 31 | 11 | 21 | 31 | 9 | 18 | 28 | - | 30 | 60 | 90 |
| 1987 | 11 | 21 | 31 | 10 | 21 | 31 | 9 | 18 | 28 | - | 30 | 60 | 90 |
| 1988 | 9 | 18 | 28 | 9 | 18 | 28 | 7 | 16 | 24 | - | 25 | 52 | 80 |
| 1989 | 9 | 18 | 28 | 9 | 18 | 28 | 7 | 16 | 24 | - | 25 | 52 | 80 |
| 1990 | 7 | 14 | 21 | 7 | 14 | 21 | 6 | 12 | 18 | - | 20 | 40 | 60 |
| Total | 87 | 158 | 237 | 87 | 158 | 237 | 71 | 144 | 206 | - | 245 | 460 | 680 |

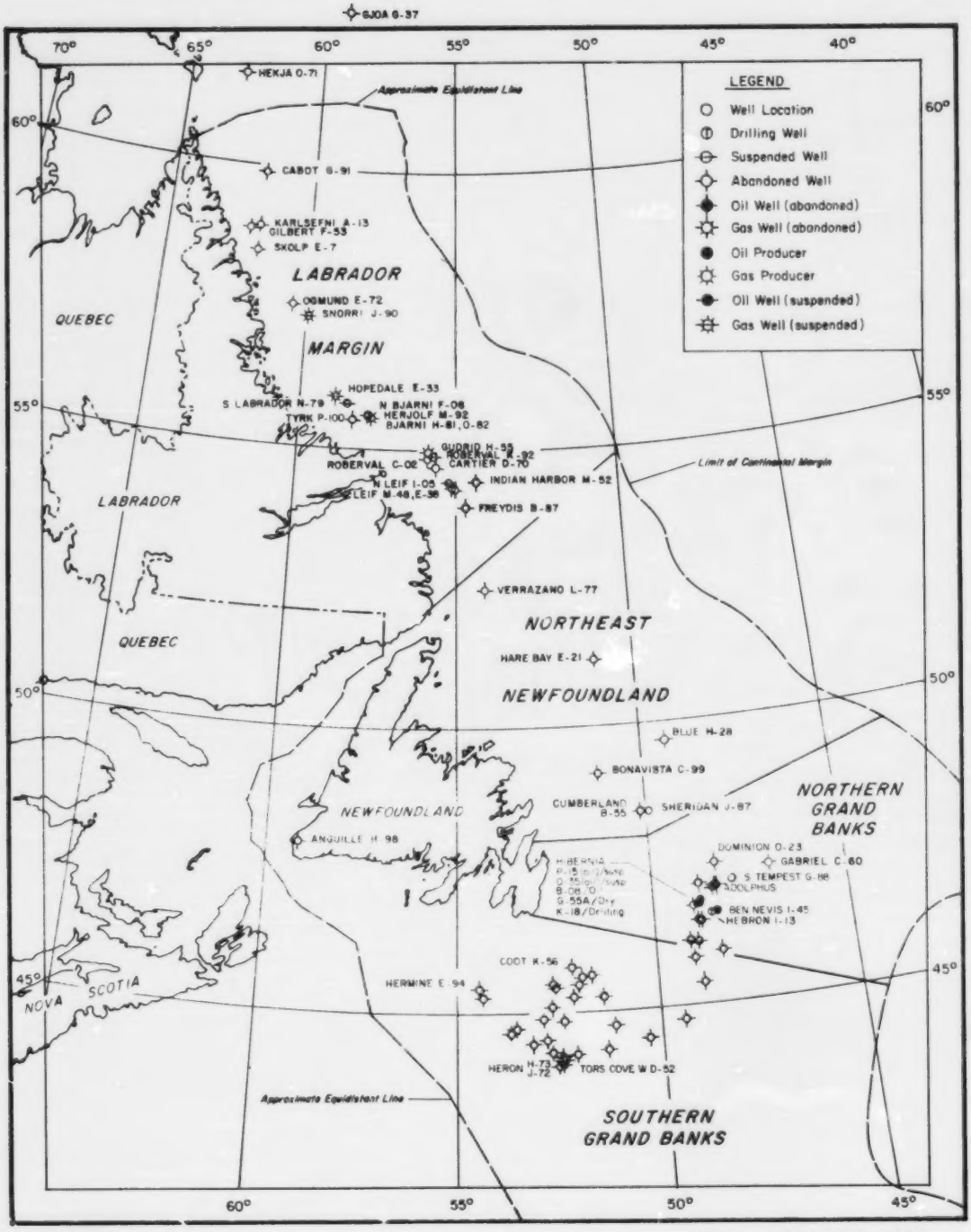



FIGURE 2 : WELL LOCATION MAP

from basalts and clastics of the Alexis Formation (up to 260 m thick) to coarse arkosic sands, shales and coals of the overlying Bjarni Formation (up to 1130 m thick). The Upper Cretaceous sediments are predominantly shales of the Cartwright Formation (1200m thick), but two sand members may be present, the Freydis (up to 70m thick and the Gudrid (up to 180m thick). Most of the Cenozoic rocks are sandy or silty mudstones of the Saglek Formation (up to 1700m thick) but one sand member (Leif) does occur locally.

The tectonic style during the Jurassic and Cretaceous was largely dominated by continental rifting as the Labrador Sea opened. During the Cretaceous, basinal areas, mainly en echelon in character, were formed by basement faulting. During the Tertiary, cyclical transgressions and regressions occurred and the present regional structure is predominantly one of monoclinal dip toward the east.

2.3.2 Major Exploration Targets

The economic basement of the Labrador Shelf is now defined in most cases as the base of Cretaceous sediments. In the past and at present, targets have been basement high areas. Sediments are draped over the highs, and wells have been drilled into the crests of a number of such structures. In some wells, a carbonate of Paleozoic age is present on the basement high and thereby forms potential reservoirs. Such is the case at the Gudrid discovery. In addition, certain stratigraphic plays exist based on onlap and updip pinchouts of sediments against the Precamberian basement as well as turbidite plays. Discoveries so far have been natural gas with some condensate. As a result, any further exploration in these shallow water areas will probably result in the discovery of more wet gas. Future efforts to discover oil can be assumed to result in more drilling on structures located in deeper water.

2.3.3 Anticipated Program

Table 2:2 gives the FEP, low and high forecasts of the wells to be drilled on the Labrador Shelf over the 10-year forecast period. Under the FEP case, four wells are forecast to be drilled in 1981, four in 1982 and two in each of the remaining eight years, for a total of 24.

Table 2:2

Forecast of
Number of Exploration Wells
Labrador Margin

| Year | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 4 | 6 | 8 |
| 1982 | 4 | 6 | 9 |
| 1983 | 2 | 6 | 9 |
| 1984 | 2 | 6 | 10 |
| 1985 | 2 | 6 | 10 |
| 1986 | 2 | 6 | 10 |
| 1987 | 2 | 6 | 10 |
| 1988 | 2 | 6 | 11 |
| 1989 | 2 | 6 | 11 |
| 1990 | 2 | 7 | 12 |
| Total | 24 | 61 | 100 |

The low case forecasts that exploration will reach a peak of seven wells by 1990 giving a total of sixty one wells over the 10 year period.

The high case anticipates a total of one hundred wells being drilled over the next 10 years

2.4 Northeast Newfoundland Shelf

2.4.1 Geological Overview

The Northeast Newfoundland Shelf comprises a major sedimentary basin (East Newfoundland Basin) which is thought to contain more than 15 km of sediment ranging in age from Jurassic to Recent. Five wildcat wells have been drilled on this shelf to date,

with no significant hydrocarbon shows. The economic basement consists of Paleozoic metamorphic rocks which are unconformably overlain by a Carboniferous clastic sequence of Mississippian and Pennyslvanian age. Carboniferous rocks generally are unconformably overlain by a Lower Cretaceous (Jurassic) sand and shale sequence and by Upper Cretaceous rocks comprising a dominantly shale sequence with some sand and siltstones. The Upper Cretaceous sediments are overlain by Tertiary clastic rocks ranging from sandstone to claystone.

### 2.4.2 Major Exploration Targets

Exploration in this shelf may presumably be concentrated along the major listric fault which bounds the Bonavista Platform from the sedimentary basins to the east. In the next 10 years, we could see major activity along the Cumberland, Bonavista and Hare Bay line as other companies use the Hibernia discovery as a geological model. Exploration may also be actively carried out in the Orphan Knoll area where significant clastic sequences could have been deposited. The East Newfoundland Basin may also be a target area because some of the largest structures (areal) on the continental margin occur within it.

### 2.4.3 Anticipated Program

Table 2:3 gives the FEP, and high forecasts, of the number of wells anticipated on the Northeast Newfoundland Shelf. It is expected that no drilling will occur in 1981. The total number of wells drilled over the 10 years is 5, 20 and 50 for each case, respectively.

## 2.5 Grand Banks

### 2.5.1 Geological Overview

The Grand Banks is underlain by an economic basement consisting of metamorphosed clastic rocks which have been intruded by plutonic and hypabyssal igneous rocks. The upper surface of this basement is an angular unconformity which in certain areas represents a time gap ranging from Middle Devonian to Quaternary. The oldest unmetamorphosed rocks are Devonian and Carboniferous in age. Triassic rocks have only been penetrated in the southern Grand Banks and form a redbed to evaporitic sequence which lies unconformably on older rocks. Jurassic rocks appear to be fairly widespread and consist of sandstones, shales, carbonates and evaporites that may exceed 3100m in thickness. Cretaceous rocks (up to 4500m thick) appear to overlie the Jurassic rocks conformably in the deeper basinal areas but are distinctively unconformable in shallower parts of the basins. The Lower Cretaceous is dominantly a sand or shale sequence which is characterized by paralic conditions at the base and more marine conditions shallower in the succession. Upper Cretaceous rocks appear conformable on those of the Lower Cretaceous in basinal areas but change to an unconformable relationship in the uplifted areas. Upper Cretaceous rocks are dominantly marine and

Table 2:3

Forecast of Number of Exploration Wells
Northeast Newfoundland

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 1 | 1 | 2 |
| 1982 | 1 | 1 | 2 |
| 1983 | 1 | 2 | 3 |
| 1984 | 1 | 2 | 5 |
| 1985 | 1 | 2 | 5 |
| 1986 | - | 2 | 6 |
| 1987 | - | 2 | 6 |
| 1988 | - | 2 | 6 |
| 1989 | - | 3 | 7 |
| 1990 | - | 3 | 8 |
| Total | 5 | 20 | 50 |

contain sands, shales and carbonates; they are unconformably overlain by a Cenozoic clastic sequence.

The Grand Banks can be divided into northern and southern areas on the basis of geology and structure.

2.5.2 Major Exploration Targets, Northern Grand Banks

The basins of the Northern Grand Banks formed as a result of extension in Triassic times as the North Atlantic opened. This resulted in the formation of a major hinge zone and growth faults on the west side of the Avalon Basin. These growth faults show continued movement through to the Tertiary in some cases. On the east side of the Avalon Basin, normal faulting and horst and graben features (ridge complex) are the most prevalent. In the very deep parts of the basin, salt diapirs are present. Further to the east, the Flemish Cap is a relict block of original basement material.

In the past, principal targets have been salt structures. The Adolphus 2K-41 well, drilled on such a structure, flowed oil at a rate of 42 cubic metres per day. In addition, wells have been drilled to test possible closures over tilted fault blocks. As a result of the Hibernia discovery, emphasis is now being given to the testing of Lower Cretaceous sands in the highly faulted hinge zone and ridge complex areas. We believe that a very significant level of exploration activity will occur in the Northern Grand Banks area in this decade.

2.5.3 Anticipated Program, Northern Grand Banks

Table 2:4 gives the FEP, low and high forecasts of the anticipated number of exploration wells to be drilled on the Northern Grand Banks area over the forecast period. This is presently the area of highest interest because of the Hibernia discovery. The forecast number of wells range from 26 to 98.

Table 2:4

Forecast of Number of Exploration Wells
Northern Grand Banks

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 4 | 4 | 5 |
| 1982 | 4 | 6 | 8 |
| 1983 | 3 | 6 | 8 |
| 1984 | 3 | 6 | 8 |
| 1985 | 2 | 6 | 10 |
| 1986 | 2 | 6 | 10 |
| 1987 | 2 | 6 | 11 |
| 1988 | 2 | 6 | 12 |
| 1989 | 2 | 7 | 12 |
| 1990 | 2 | 7 | 14 |
| Total | 26 | 60 | 98 |

2.5.4 Major Exploration Targets, Southern Grand Banks

The basins of the southern Grand Banks also formed as a result of extention, as in the northern area. As a result, horst and graben features are common, with some strike-slip motion evident. Within the fault blocks, salt flowage modified and deformed nonevaporitic sediments. Salt domes and diapirs are of medium piercement (upwards into the Tertiary section), shallow piercement (bowing the Jurassic-Cretaceous unconformity), and deep seated (do not affect the unconformity). The salt is believed to be of Upper Triassic to Jurassic in age.

In the past, most of the wells drilled on the Southern Grand Banks were drilled into or near some kind of salt structure, either a dome, diapir or ridge. At present, there is no activity in the area. In the future, wells will probably be drilled for sands that are draped over high basement fault blocks, or where

Cretaceous sands onlap a basin. Also, follow-up wells might be drilled in areas of previous shows in Jurassic carbonates (e.g. Murre), or in such areas as the Carson and Whale subbasins.

2.5.5 Anticipated Program on the Southern Grand Banks

Table 2:5 gives the forecast of the anticipated number of wells to be drilled on the Southern Grand Banks area. Under the FEP case, neither well is forecast for 1981 or 1982 and only one per year throughout the remainder of the forecast period for a total of eight. Under the low case, a total of 13 wells are forecast while under the high case, a total of 31 are forecast.

Table 2:6 presents the total number of exploration wells anticipated to be drilled offshore Newfoundland and Labrador over the 10 year forecast period for all areas combined.

Table 2:5

Forecast of Number of Exploration Wells
Southern Grand Banks

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | - | - | - |
| 1982 | - | 1 | 2 |
| 1983 | 1 | 1 | 3 |
| 1984 | 1 | 1 | 3 |
| 1985 | 1 | 1 | 3 |
| 1986 | 1 | 1 | 3 |
| 1987 | 1 | 2 | 4 |
| 1988 | 1 | 2 | 4 |
| 1989 | 1 | 2 | 4 |
| 1990 | 1 | 2 | 5 |
| Total | 8 | 13 | 31 |

Table 2:6

Total Number of Exploration Wells
Offshore Newfoundland and Labrador

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 9 | 11 | 15 |
| 1982 | 9 | 14 | 21 |
| 1983 | 7 | 15 | 23 |
| 1984 | 7 | 15 | 26 |
| 1985 | 6 | 15 | 28 |
| 1986 | 5 | 15 | 29 |
| 1987 | 5 | 16 | 31 |
| 1988 | 5 | 16 | 33 |
| 1989 | 5 | 18 | 34 |
| 1990 | 5 | 19 | 39 |
| Total | 63 | 154 | 279 |

## 3. Exploration Activity

### 3.1 Current and Possible Land Position of Newfoundland Permittees

Nine exploration companies presently hold 236,953 square kilometers under provincial exploratory permits pursuant to the Newfoundland and Labrador Petroleum Regulations, 1977, offshore Newfoundland and Labrador. This represents 120 exploratory permits issued by the province.

Also, the province recently has transferred 20 exploratory permits, representing 3,900,000 hectares of Crown reserve land, to the Newfoundland and Labrador Petroleum Corporation pursuant to the Petroleum and Natural Gas (Crown Reserves) Regulations, 1980.

The province's jurisdictional area is divided into ten management zones according to water depths and ice and weather conditions. The term, size, etc. of the exploration permit are determined by the management zone in which it is situated.

An exploratory permit grants the permittee the nonexclusive right to carry out reconnaissance surveys for petroleum in the permit area and the exclusive right to drill for petroleum in the permit area. The permittee also has the right to convert to lease. This right to convert extends to all or any part of a permit area underlain by any discovery made during the exploration or appraisal period or any extension thereof, provided at least one such discovery has been made before the end of the exploration period or any extension thereof.

It is deemed to be a condition of every exploratory permit that the permit shall grant to the permittee the right to have a three year extension of the exploration period. This extension is conditional upon the permittee,prior to the start of such extension, having relinquished at least 40 percent of the original number of sections contained in his permit or group of permits and on having made a committment to drill the number of wells stipulated in his permit for such a period.

As mentioned previously, an exploratory permit's term depends on the management zone in which it is situated . Not all exploratory permits issued offshore Newfoundland and Labrador are situated in similar management zones. They are, therefore, subject to different exploration periods. Regardless of their exploration term, however, they all carry the right to a 3-year extension subject to the 40% relinquishment requirement, as mentioned above. If all permittees, currently holding exploratory permits, exercise this right to a 3-year extension, we can anticipate land relinquishment of 40 percent up to the year 1986, which represents the end of the last initial exploration term of the current permittees.

### 3.2 The Exploration Policy of the Provincial Government

It is the exploration policy of the provincial government to provide conditions sufficiently attractive to maintain an adequate level of exploration. To influence the rate of development, the province carefully controls the area being explored at any time. As illustrated in Section 3.1, the companies can retain the most attractive part of their permit areas through the 1980's under conditions set down in the regulations.

All exploration is now taking place on permit areas granted in the so-called first round. A decision on the timing of a possible second round issuance of permits has not been made. Such a second round may be needed, however, if the number of

discoveries is less than adequate.

Drilling plans have not yet been formulated for permits issued to NLPC.

The federal government has indicated that it wants Petro-Canada to play a major role in the development of offshore oil and gas. It is our position that Petro-Canada is welcome to expand its role in exploration provided it complies with provincial petroleum regulations.

The provincial policy on exploration has been designed to produce an adequate level of exploration and development assuming that the prospectiveness of the area is favourable. The recent federal energy policy is having a negative impact on the planned level of activity.

3.3 Effects of The Federal Energy Policy

In an earlier publication of the Petroleum Directorate (PD 81-1), a detailed analysis was made of the effects of the new federal energy policy on offshore exploration of Newfoundland and Labrador.

We concluded in that publication that the full cycle rate of return of a typical exploration project has declined as a result of the federal policy by about three percentage points, from 23% to 20%. A full cycle rate of return of 20% is relatively low compared to current prime lending rates in Canada. Therefore, exploration and development must be only marginally attractive for firms less than 75% Canadian owned; this includes most companies currently involved in exploration. For companies 100% Canadian owned the rate is 21%. This is clearly not much better.

It should be noted that our calculations were done on the basis of a hypothetical probability of success of a commercial discovery of 1:20. Few areas offshore Newfoundland and Labrador warrant such a high ratio. Therefore, we conclude that exploration in many areas in the offshore is now unattractive as a result of the federal energy policy.

It is still difficult to assess the precise impact of the FEP because the federal energy policy is still evolving and many oil companies are still evaluating the situation. Therefore, the FEP forecasts in Chapter 2 must be considered very preliminary.

## 4. Forecast of Economic Impact

### 4.1 Overview

Investments by the petroleum industry in exploration offshore Newfoundland and Labrador will have considerable impact on the economy of the province over the 10-year forecast period. The demand for goods, services and employment will provide numerous opportunities for the province to participate in this exploration activity.

This chapter provides detailed information on the quantities of goods and services by major expenditure item, manpower requirements by major employment category, and the total cost in terms of resulting wages and salaries and expenditures on goods and services for each of the FEP, low and high forecasts.

### 4.2 Goods and Services

The amounts of goods and services consumed in connection with offshore oil and gas exploration activities are separated into the following categories: rig days, supply boat days, helicopter days, seismic vessel days, fuel, drilling fluid additives, casing and cement.

Tables 4:1, 4:2, 4:3 and 4:4 give FEP, the low and high forecasts for drilling rig days, supply boat days, helicopter days and seismic boat days, respectively.

Rig days refer to the number of days associated with drilling a well and include location days, drilling days, evaluation days, casing days, abandonment days as well as any time lost due to weather or well problems, etc.

Location days are calculated based on the average days required by a drilling rig to mobilize and demobilize between points within the province's offshore area. Drilling, or rotating days represent the time necessary to drill to total depth and, therefore, increase with depth. Evaluation, casing and abandonment days are calculated as a function of well depth.

Table 4:1

Forecast of Drilling Rig Days

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 1146 | 1307 | 1681 |
| 1982 | 1187 | 1708 | 2590 |
| 1983 | 771 | 1810 | 2793 |
| 1984 | 850 | 1701 | 3208 |
| 1985 | 634 | 1995 | 3394 |
| 1986 | 667 | 1866 | 3241 |
| 1987 | 685 | 1987 | 3841 |
| 1988 | 628 | 1849 | 3395 |
| 1989 | 711 | 1962 | 3491 |
| 1990 | 587 | 2159 | 4432 |
| Total | 7866 | 18344 | 32066 |

Supply boat days refer to the number of days of supply boat service required to provide the rigs with a continuing supply of goods and services in order to maintain operations. Supply boat days are calculated based on the number of days a rig is on site at a particular well. The ratio, calculated on the

Table 4:2

Forecast of Supply Boat Days

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 3329 | 3794 | 4873 |
| 1982 | 3457 | 4959 | 7526 |
| 1983 | 2235 | 5267 | 8139 |
| 1984 | 2473 | 4956 | 9360 |
| 1985 | 1839 | 5835 | 9895 |
| 1986 | 1943 | 5462 | 9428 |
| 1987 | 1999 | 5787 | 11197 |
| 1988 | 1833 | 5383 | 9843 |
| 1989 | 2084 | 5701 | 10141 |
| 1990 | 1706 | 6280 | 12908 |
| Total | 22898 | 53414 | 93310 |

bases of historical data, is three supply boat days for every rig day on site. It is assumed that there is a supply boat at the rig at all times.

Helicopter days refer to the number of days helicopter service is required to support the rigs. Helicopters are used primarily to ferry rig personnel between the rigs and the base and to provide emergency services. There is normally a one to one relationship between rigs and helicopters. Helicopter days, therefore, closely parallel rig days, being less by the days necessary for the rig to achieve location.

Table 4:3

Forecast of Helicopter Days

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 1109 | 1264 | 1624 |
| 1982 | 1152 | 1652 | 2507 |
| 1983 | 744 | 1755 | 2712 |
| 1984 | 825 | 1650 | 3120 |
| 1985 | 612 | 1944 | 3298 |
| 1986 | 648 | 1819 | 3140 |
| 1987 | 666 | 1929 | 3734 |
| 1988 | 611 | 1793 | 3280 |
| 1989 | 694 | 1900 | 3377 |
| 1990 | 568 | 2092 | 4303 |
| Total | 7629 | 17798 | 31095 |

Table 4:4

Forecast of Seismic Boat Days

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 504 | 754 | 1004 |
| 1982 | 504 | 754 | 1004 |
| 1983 | 629 | 1054 | 1504 |
| 1984 | 629 | 1054 | 1504 |
| 1985 | 629 | 1304 | 2004 |
| 1986 | 754 | 1504 | 2254 |
| 1987 | 754 | 1504 | 2254 |
| 1988 | 629 | 1304 | 2004 |
| 1989 | 629 | 1304 | 2004 |
| 1990 | 504 | 1004 | 1504 |
| Total | 6165 | 11540 | 17040 |

Seismic boat days are the days required to complete a seismic program. The number of seismic boat days is based on the assumption that seismic boats can operate for approximately one half the year over much of the continental margin. The average number of line kilometers shot per day is assumed, on the basis of historical data, to be 40.

Tables 4:5, 4:6, 4:7 and 4:8 give FEP, low and high forecasts of the number of drilling rigs, supply boats, helicopters and seismic boats, respectively. The numbers given assume that rigs conducting the exploratory program are optimally allocated.

Table 4:5

Forecast of Number of Drilling Rigs

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 6 | 9 | 12 |
| 1982 | 7 | 10 | 15 |
| 1983 | 5 | 12 | 20 |
| 1984 | 6 | 14 | 23 |
| 1985 | 5 | 14 | 25 |
| 1986 | 4 | 15 | 24 |
| 1987 | 4 | 13 | 27 |
| 1988 | 5 | 14 | 28 |
| 1989 | 5 | 16 | 29 |
| 1990 | 4 | 16 | 35 |

Table 4:6

Forecast of Number of Supply Boats

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 18 | 27 | 36 |
| 1982 | 21 | 30 | 45 |
| 1983 | 15 | 36 | 60 |
| 1984 | 18 | 42 | 69 |
| 1985 | 15 | 42 | 75 |
| 1986 | 12 | 45 | 72 |
| 1987 | 12 | 39 | 81 |
| 1988 | 15 | 42 | 84 |
| 1989 | 15 | 48 | 87 |
| 1990 | 12 | 48 | 105 |

Table 4:7

Forecast of Number of Helicopters

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 6 | 9 | 12 |
| 1982 | 7 | 10 | 15 |
| 1983 | 5 | 12 | 20 |
| 1984 | 6 | 14 | 23 |
| 1985 | 5 | 14 | 25 |
| 1986 | 4 | 15 | 24 |
| 1987 | 4 | 13 | 27 |
| 1988 | 5 | 14 | 28 |
| 1989 | 5 | 16 | 29 |
| 1990 | 4 | 16 | 35 |

Table 4:8

Forecast of Number of Seismic Boats

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 3 | 5 | 6 |
| 1982 | 3 | 5 | 6 |
| 1983 | 4 | 6 | 9 |
| 1984 | 4 | 6 | 9 |
| 1985 | 4 | 8 | 12 |
| 1986 | 5 | 9 | 13 |
| 1987 | 5 | 9 | 13 |
| 1988 | 4 | 8 | 12 |
| 1989 | 4 | 8 | 12 |
| 1990 | 3 | 6 | 9 |

Table 4:9 gives the FEP, low and high forecasts for marine and jet fuel in tonnes. Marine fuel, mainly diesel, is used in rig, supply boat, and seismic boat operations. Jet fuel is used in fixed wing and helicopter operations. Fuel consumed is calculated on the basis of distances travelled, trips made and speed in the case of helicopters, supply boats and seismic boats. In the case of rigs, the fuel calculations are more involved. Separate calculations are made depending upon (1) whether the rig is moving or stationary, (2) the type of rig and (3) whether it is dynamically positioned or moored.

Table 4:10 gives the FEP, low and high forecasts for drilling fluid additives. Drilling fluid is used to lubricate the bit and the drill string, to remove drilled solids, to control subsurface pressures, etc. Drilling fluid additives are divided into three main categories: barite, bentonite and other additives. Barite accounts for approximately 70% of drilling fluid additives by quantity, bentonite approximately 17%, and all other approximately 13%. The quantity of drilling fluid used depends mainly on the geological conditions encountered and the depth of the well.

Table 4:11

Forecast of Cement
(tonnes)

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 2924 | 3454 | 4540 |
| 1982 | 2959 | 4312 | 6561 |
| 1983 | 1904 | 4570 | 6997 |
| 1984 | 2067 | 4355 | 8158 |
| 1985 | 1600 | 4960 | 8558 |
| 1986 | 1642 | 4759 | 8091 |
| 1987 | 1692 | 5067 | 9387 |
| 1988 | 1607 | 4632 | 8919 |
| 1989 | 1778 | 5019 | 8866 |
| 1990 | 1502 | 5420 | 10888 |
| Total | 19674 | 46547 | 80964 |

Table 4:12

Forecast of Casing
(tonnes)

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 3577 | 4186 | 5505 |
| 1982 | 3629 | 5314 | 8088 |
| 1983 | 2420 | 5675 | 8687 |
| 1984 | 2605 | 5410 | 10075 |
| 1985 | 2023 | 6110 | 10620 |
| 1986 | 2029 | 5867 | 10186 |
| 1987 | 2078 | 6240 | 11748 |
| 1988 | 1974 | 5795 | 11161 |
| 1989 | 2162 | 6288 | 11197 |
| 1990 | 1865 | 6768 | 13767 |
| Total | 24362 | 57653 | 101033 |

Tables 4:11 and 4:12 give the FEP,

Table 4:9

Forecast of Fuel
(tonnes)

| Year | Marine | | | Jet | | |
|---|---|---|---|---|---|---|
| | FEP | Low | High | FEP | Low | High |
| 1981 | 76684 | 90161 | 120967 | 1369 | 1541 | 2085 |
| 1982 | 85202 | 114830 | 164922 | 1573 | 2195 | 3096 |
| 1983 | 45946 | 121643 | 186543 | 874 | 2333 | 3677 |
| 1984 | 58316 | 119391 | 236158 | 1133 | 2413 | 4719 |
| 1985 | 43700 | 133482 | 242865 | 840 | 2594 | 4684 |
| 1986 | 46988 | 155279 | 221609 | 862 | 2913 | 4794 |
| 1987 | 44604 | 152922 | 286589 | 784 | 2836 | 6010 |
| 1988 | 45745 | 122487 | 237196 | 846 | 2534 | 5088 |
| 1989 | 65054 | 142410 | 226729 | 1115 | 2949 | 4849 |
| 1990 | 42939 | 158621 | 295069 | 828 | 3374 | 6563 |
| Total | 555176 | 1311225 | 2218648 | 10224 | 25682 | 45565 |

Table 4:10

Forecast of Drilling Fluid Additives
(Tonnes)

| Year | Barite | | | Bentonite | | | Other Additives | | |
|---|---|---|---|---|---|---|---|---|---|
| | FEP | Low | High | FEP | Low | High | FEP | Low | High |
| 1981 | 5822 | 7034 | 9168 | 1353 | 1643 | 2139 | 1110 | 1397 | 1808 |
| 1982 | 6186 | 9228 | 15295 | 1436 | 2143 | 3551 | 1170 | 1743 | 2887 |
| 1983 | 5945 | 12769 | 19335 | 1370 | 2961 | 4477 | 1049 | 2380 | 3560 |
| 1984 | 6957 | 13447 | 24553 | 1604 | 3108 | 5686 | 1230 | 2436 | 4525 |
| 1985 | 5106 | 13943 | 25209 | 1177 | 3231 | 5828 | 902 | 2582 | 4576 |
| 1986 | 4006 | 14439 | 26459 | 929 | 3344 | 6107 | 744 | 2661 | 4732 |
| 1987 | 4564 | 14067 | 28486 | 1057 | 3256 | 6580 | 841 | 2580 | 5128 |
| 1988 | 4446 | 14081 | 31237 | 1029 | 3252 | 7209 | 815 | 2528 | 5578 |
| 1989 | 4242 | 15995 | 31863 | 984 | 3692 | 7352 | 795 | 2862 | 5679 |
| 1990 | 3870 | 16520 | 42944 | 895 | 3815 | 9898 | 706 | 2968 | 7569 |
| Total | 51145 | 131524 | 254548 | 11835 | 30443 | 58827 | 9361 | 24135 | 46043 |

low and high forecasts of the cement and casing requirements, respectively. Casing refers to the steel pipe used to line the borehole. This pipe serves several functions, including prevention of caving of the borehole, anchorage for the blowout preventor (BOP) and to prevent contamination of the reservoir. When casing is in place, it is cemented into position. Cement is also used in abandonment and suspension procedures.

## 4.3 Employment

Although offshore exploration for oil and gas is highly capital intensive, there is a significant labour component. Indeed, at present, the employment opportunities generated probably represent the most significant single impact on the provincial economy resulting from offshore exploration activity. This section presents a forecast of employment associated with exploration over the 10-year forecast period.

The employment forecast is broken into five major categories: drilling crew, offshore support crew, marine crew, onshore support personnel and seismic operations personnel. Each category is reported by manyears and by peak number. In all cases, the FEP, low and high forecasts are given.

Table 4:13

Forecast of Drilling Crew Employment
(Manyears)

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 225 | 256 | 329 |
| 1982 | 234 | 335 | 508 |
| 1983 | 151 | 356 | 550 |
| 1984 | 167 | 334 | 633 |
| 1985 | 124 | 394 | 669 |
| 1986 | 131 | 369 | 637 |
| 1987 | 135 | 391 | 757 |
| 1988 | 124 | 364 | 665 |
| 1989 | 141 | 385 | 685 |
| 1990 | 115 | 425 | 872 |
| Total | 1547 | 3610 | 6306 |

Table 4:14

Forecast of Peak Drilling
Crew Employment
(Individuals)

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 444 | 666 | 888 |
| 1982 | 518 | 740 | 1110 |
| 1983 | 370 | 888 | 1480 |
| 1984 | 444 | 1036 | 1702 |
| 1985 | 370 | 1036 | 1850 |
| 1986 | 296 | 1110 | 1776 |
| 1987 | 296 | 962 | 1998 |
| 1988 | 370 | 1036 | 2072 |
| 1989 | 370 | 1184 | 2146 |
| 1990 | 296 | 1184 | 2590 |

Tables 4:13 and 4:14 give drilling crew employment in manyears and peak numbers, respectively. Occupations included within the drilling crew are rig superintendants, tool pushers, drillers, subsea engineers, derrickmen, roughnecks, roustabouts, crane operators, electricians, welders, mechanics and storemen.

Tables 4:15 and 4:16 give the forecasts for offshore support crew in manyears and peak numbers, respectively. Offshore support crew are those support personnel actually employed on the rig and supply boat and include such occupations as

Table 4:15

Forecast of Support Crew Employment
(Manyears)

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 193 | 224 | 289 |
| 1982 | 199 | 287 | 432 |
| 1983 | 137 | 312 | 478 |
| 1984 | 150 | 295 | 544 |
| 1985 | 116 | 349 | 586 |
| 1986 | 125 | 334 | 568 |
| 1987 | 128 | 352 | 663 |
| 1988 | 116 | 325 | 583 |
| 1989 | 129 | 342 | 600 |
| 1990 | 105 | 365 | 734 |
| Total | 1398 | 3184 | 5478 |

Table 4:16

Forecast of Peak Support Crew Employment
(Individuals)

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 382 | 578 | 765 |
| 1982 | 441 | 637 | 941 |
| 1983 | 333 | 765 | 1265 |
| 1984 | 392 | 882 | 1441 |
| 1985 | 333 | 902 | 1588 |
| 1986 | 284 | 971 | 1539 |
| 1987 | 284 | 853 | 1716 |
| 1988 | 333 | 902 | 1765 |
| 1989 | 333 | 1020 | 1824 |
| 1990 | 264 | 1000 | 2147 |

medics, radio operators, cooks, stewards, utility personnel, ice observers, divers, logging engineers, logging operators, cementing engineers, drilling mud engineers, drilling mud operators and drilling mud technicians.

Tables 4:17 and 4:18 give forecasts of marine crew employment in manyears and peak numbers, respectively. Marine crew include those on the rigs, supply boats and seismic vessels. The category includes such occupations as masters, mates, boatswains, seamen, marine engineers and oilers. This category also includes additional personnel required on dynamicially positioned drilling rigs.

Table 4:17

Forecast of Marine Crew Employment
(Manyears)

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 286 | 334 | 437 |
| 1982 | 301 | 428 | 649 |
| 1983 | 208 | 482 | 756 |
| 1984 | 235 | 468 | 875 |
| 1985 | 179 | 558 | 936 |
| 1986 | 191 | 548 | 896 |
| 1987 | 194 | 550 | 1062 |
| 1988 | 185 | 511 | 930 |
| 1989 | 209 | 543 | 963 |
| 1990 | 159 | 579 | 1202 |
| Total | 2147 | 5001 | 8704 |

Table 4:18

Forecast of Peak Marine Crew Employment
(Individuals)

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 602 | 910 | 1224 |
| 1982 | 702 | 1010 | 1504 |
| 1983 | 536 | 1244 | 2066 |
| 1984 | 636 | 1444 | 2386 |
| 1985 | 536 | 1472 | 2608 |
| 1986 | 450 | 1606 | 2522 |
| 1987 | 450 | 1386 | 2822 |
| 1988 | 536 | 1472 | 2908 |
| 1989 | 536 | 1672 | 3008 |
| 1990 | 422 | 1644 | 3586 |

Tables 4:19 and 4:20 give the forecasts for seismic operations employment in manyears and peak numbers, respectively. Seismic operations employment includes occupations on a seismic boat such as seismic party managers, systems engineers, mechanics and navigation personnel.

Table 4:19

Forecast of Seismic Operations Employment
(Manyears)

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 43 | 64 | 85 |
| 1982 | 43 | 64 | 85 |
| 1983 | 53 | 90 | 128 |
| 1984 | 53 | 90 | 128 |
| 1985 | 53 | 111 | 170 |
| 1986 | 64 | 128 | 191 |
| 1987 | 64 | 128 | 191 |
| 1988 | 53 | 111 | 170 |
| 1989 | 53 | 111 | 170 |
| 1990 | 43 | 85 | 128 |
| Total | 524 | 980 | 1447 |

Table 4:20

Forecast of Peak Seismic Operations Employment (Individuals)

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 93 | 155 | 186 |
| 1982 | 93 | 155 | 186 |
| 1983 | 124 | 186 | 279 |
| 1984 | 124 | 186 | 279 |
| 1985 | 124 | 248 | 372 |
| 1986 | 155 | 279 | 403 |
| 1987 | 155 | 279 | 403 |
| 1988 | 124 | 248 | 372 |
| 1989 | 124 | 248 | 372 |
| 1990 | 93 | 186 | 279 |

Tables 4:21 and 4:22 give the forecasts for onshore employment in manyears and peak numbers, respectively. Onshore employment provides support to the rigs operating in the offshore. Included in this category are office personnel employed by the operating and service companies as well as such occupations as helicopter pilots and maintenance personnel, warehouse men, dockworkers, storemen, meteorologists, clerks, typists and managers employed directly in the offshore activities.

Table 4:21

Forecast of Onshore Employment (Manyears)

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 155 | 167 | 195 |
| 1982 | 193 | 267 | 367 |
| 1983 | 162 | 310 | 383 |
| 1984 | 203 | 302 | 449 |
| 1985 | 187 | 324 | 463 |
| 1986 | 190 | 350 | 486 |
| 1987 | 156 | 358 | 531 |
| 1988 | 152 | 313 | 497 |
| 1989 | 158 | 321 | 539 |
| 1990 | 149 | 336 | 610 |
| Total | 1706 | 3046 | 4521 |

Table 4:22

Forecast of Peak Onshore Employment (Individuals)

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 153 | 186 | 219 |
| 1982 | 199 | 267 | 357 |
| 1983 | 177 | 324 | 412 |
| 1984 | 223 | 346 | 480 |
| 1985 | 212 | 346 | 502 |
| 1986 | 201 | 392 | 526 |
| 1987 | 166 | 370 | 559 |
| 1988 | 177 | 346 | 570 |
| 1989 | 177 | 368 | 616 |
| 1990 | 166 | 368 | 682 |

Table 4:23

Forecast of Total Employment (Manyears)

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 721 | 835 | 1064 |
| 1982 | 784 | 1112 | 1637 |
| 1983 | 583 | 1257 | 1847 |
| 1984 | 668 | 1211 | 2119 |
| 1985 | 551 | 1409 | 2274 |
| 1986 | 583 | 1415 | 2245 |
| 1987 | 557 | 1448 | 2582 |
| 1988 | 521 | 1317 | 2298 |
| 1989 | 569 | 1381 | 2395 |
| 1990 | 472 | 1447 | 2859 |
| Total | 6008 | 12832 | 21319 |

Table 4:24

Forecast of Total Peak Employment (Individuals)

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 1674 | 2495 | 3282 |
| 1982 | 1953 | 2809 | 4098 |
| 1983 | 1540 | 3407 | 5502 |
| 1984 | 1819 | 3894 | 6288 |
| 1985 | 1575 | 4004 | 6920 |
| 1986 | 1386 | 4358 | 6766 |
| 1987 | 1351 | 3850 | 7498 |
| 1988 | 1540 | 4004 | 7687 |
| 1989 | 1540 | 4492 | 7966 |
| 1990 | 1241 | 4382 | 9284 |

Tables 4:23 and 4:24 provide the forecasts of total employment in manyears and peak numbers of the total employment aggregated for all categories.

Associated with these employment levels is a considerable expenditure in the form of wages and salaries.

Tables 4:25 and 4:26 give a forecast of total wages and salaries associated with employment in the offshore exploration activities in current and constant 1981 dollars, respectively.

Table 4:25

Total Wages and Salaries
($ Millions Cdn. Current)

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 26 | 30 | 39 |
| 1982 | 31 | 44 | 65 |
| 1983 | 24 | 54 | 80 |
| 1984 | 30 | 56 | 101 |
| 1985 | 27 | 73 | 119 |
| 1986 | 32 | 79 | 128 |
| 1987 | 34 | 90 | 163 |
| 1988 | 35 | 90 | 159 |
| 1989 | 42 | 104 | 182 |
| 1990 | 38 | 121 | 241 |
| Total | 318 | 740 | 1275 |

Table 4:26

Total Wages and Salaries
($ Millions Cdn. 1981)

| YEAR | FEP | LOW | HIGH |
|---|---|---|---|
| 1981 | 26 | 30 | 39 |
| 1982 | 28 | 40 | 59 |
| 1983 | 20 | 44 | 66 |
| 1984 | 23 | 42 | 76 |
| 1985 | 18 | 50 | 81 |
| 1986 | 20 | 49 | 80 |
| 1987 | 19 | 51 | 92 |
| 1988 | 18 | 46 | 82 |
| 1989 | 20 | 49 | 85 |
| 1990 | 16 | 51 | 102 |
| Total | 207 | 452 | 760 |

In terms of the provincial accounts, wages and salaries include such items as executive salaries and bonuses, commissions, payments in kind, incentive payments and tips. This report attempts to parallel this definition to the extent possible. Because of the difficulty of estimating bonuses, commissions, incentive payments, etc., the wage and salary estimates contained in this report may be understated.

## 4.4 Total Expenditures

Until now, we have been discussing economic impact in terms of goods and services by major category, related levels of employment, and the accompanying wages and salaries. This section presents a forecast of the economic impact as measured in terms of total expenditures.

Tables 4:27, 4:28 and 4:29 give total expenditures by major category in current dollars for each of the FEP, low and high exploration forecasts, respectively. Tables 4:30, 4:31 and 4:32 give the same figures in constant 1981 dollars. Expenditures on oil and gas exploration have been categorized into those expenditures pertaining to rig days, supply boat days, helicopter days, fuel, drilling fluid additives, cement, casing, seismics and other operations.

The expenditures on rigs comprise the largest single component of total well costs and are calculated as a rate per day multiplied by the number of rig days employed. Supply boat and helicopter expenditures are also calculated as a rate per day multiplied by the number of days employed.

Seismic costs refer to the cost of acquiring and processing the seismic data and depends on the number of line kilometres of surveys.

Fuel cost is a function of the cost per tonne and the number of tonnes consumed by the rigs, the supply boats, the seismic vessels and

Table 4:27

Total Expenditures by Major Category
FEP Case
($ Millions Cdn. Current)

| Year | Rigs | Supply Boats | Heli-copters | Total Fuel | Mud | Cement | Casing | Logging | Seismic | Other | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1981 | 130.74 | 28.30 | 10.11 | 14.51 | 6.79 | 2.14 | 11.22 | 9.10 | 21.00 | 78.50 | 312.40 |
| 1982 | 154.50 | 32.91 | 12.20 | 17.44 | 7.83 | 2.39 | 12.53 | 10.39 | 23.10 | 92.28 | 365.56 |
| 1983 | 113.34 | 23.81 | 8.47 | 10.17 | 6.74 | 1.74 | 9.20 | 7.39 | 31.76 | 66.53 | 279.15 |
| 1984 | 144.36 | 29.53 | 11.24 | 13.96 | 8.47 | 2.06 | 10.89 | 9.00 | 34.94 | 84.50 | 348.95 |
| 1985 | 119.36 | 24.60 | 9.05 | 11.29 | 6.88 | 1.76 | 9.30 | 7.36 | 38.43 | 67.70 | 297.74 |
| 1986 | 139.29 | 29.13 | 10.27 | 13.08 | 6.88 | 1.95 | 10.26 | 8.56 | 50.73 | 80.59 | 350.72 |
| 1987 | 159.29 | 33.52 | 11.14 | 13.38 | 8.17 | 2.20 | 11.56 | 9.67 | 55.80 | 91.47 | 396.20 |
| 1988 | 172.44 | 34.43 | 12.69 | 14.86 | 8.50 | 2.29 | 12.07 | 9.76 | 51.15 | 98.23 | 416.44 |
| 1989 | 221.96 | 43.85 | 16.82 | 22.74 | 9.76 | 2.77 | 14.54 | 12.21 | 56.27 | 126.90 | 527.82 |
| 1990 | 190.14 | 40.22 | 13.26 | 16.31 | 9.25 | 2.62 | 13.81 | 11.00 | 49.52 | 109.20 | 455.31 |
| Total | 1545.42 | 320.30 | 115.24 | 147.75 | 79.26 | 21.91 | 115.38 | 94.44 | 412.71 | 897.89 | 3750.92 |

Table 4:28

Total Expenditures by Major Category
Low Case
($ Millions Cdn. Current)

| Year | Rigs | Supply Boats | Heli-copters | Total Fuel | Mud | Cement | Casing | Logging | Seismic | Other | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1981 | 149.73 | 32.24 | 11.56 | 17.03 | 7.97 | 2.52 | 13.13 | 10.37 | 31.50 | 90.08 | 366.12 |
| 1982 | 219.46 | 47.20 | 17.06 | 23.55 | 11.43 | 3.50 | 18.35 | 14.91 | 34.65 | 131.08 | 521.18 |
| 1983 | 270.72 | 56.14 | 21.11 | 26.95 | 15.19 | 4.09 | 29.78 | 17.42 | 53.36 | 159.62 | 646.15 |
| 1984 | 292.41 | 59.07 | 23.29 | 28.64 | 16.65 | 4.30 | 13.56 | 18.00 | 58.70 | 171.33 | 694.99 |
| 1985 | 388.48 | 78.05 | 29.83 | 34.51 | 20.20 | 5.33 | 28.08 | 23.35 | 79.94 | 223.95 | 911.72 |
| 1986 | 418.89 | 81.79 | 33.58 | 43.28 | 21.94 | 5.63 | 29.66 | 24.04 | 101.46 | 242.58 | 1002.85 |
| 1987 | 473.81 | 97.10 | 35.59 | 46.01 | 24.44 | 6.59 | 34.70 | 28.02 | 111.61 | 274.84 | 1132.71 |
| 1988 | 496.37 | 101.13 | 36.28 | 40.03 | 25.95 | 6.73 | 35.46 | 28.67 | 106.40 | 283.94 | 1160.95 |
| 1989 | 595.42 | 119.96 | 44.06 | 50.27 | 31.42 | 8.03 | 42.33 | 33.40 | 117.04 | 340.92 | 1382.83 |
| 1990 | 730.45 | 148.09 | 53.56 | 60.56 | 36.76 | 9.54 | 50.11 | 40.49 | 99.03 | 416.87 | 1645.47 |
| Total | 4035.73 | 820.77 | 305.91 | 370.82 | 211.95 | 56.27 | 295.97 | 238.65 | 793.69 | 2335.21 | 9464.97 |

Table 4:29

Total Expenditures by Major Category
High Case
($ Millions Cdn. Current)

| Year | Rigs | Supply Boats | Heli-copters | Total Fuel | Mud | Cement | Casing | Logging | Seismic | Other | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1981 | 195.22 | 41.42 | 15.40 | 22.85 | 10.30 | 3.32 | 17.27 | 13.32 | 42.00 | 117.53 | 478.63 |
| 1982 | 335.06 | 71.62 | 25.63 | 33.79 | 18.08 | 5.31 | 27.92 | 22.62 | 46.20 | 199.23 | 785.47 |
| 1983 | 426.75 | 86.79 | 33.82 | 41.38 | 23.21 | 6.27 | 33.00 | 26.92 | 76.23 | 249.97 | 1004.33 |
| 1984 | 558.01 | 111.79 | 45.10 | 56.62 | 30.95 | 7.99 | 42.09 | 34.06 | 83.85 | 327.04 | 1297.50 |
| 1985 | 657.70 | 132.35 | 51.19 | 62.77 | 35.38 | 9.27 | 48.82 | 39.60 | 122.98 | 382.26 | 1542.30 |
| 1986 | 695.68 | 141.22 | 53.91 | 62.25 | 39.04 | 9.77 | 51.52 | 41.50 | 152.19 | 403.34 | 1650.43 |
| 1987 | 936.21 | 187.89 | 72.92 | 86.79 | 48.37 | 12.39 | 65.35 | 54.23 | 167.41 | 539.82 | 2171.37 |
| 1988 | 920.60 | 184.95 | 69.33 | 77.68 | 52.92 | 12.96 | 68.30 | 52.42 | 163.69 | 530.66 | 2133.50 |
| 1989 | 1068.88 | 213.46 | 77.62 | 80.18 | 59.62 | 14.35 | 75.39 | 59.43 | 180.06 | 608.12 | 2437.10 |
| 1990 | 1541.39 | 304.27 | 112.66 | 112.95 | 86.26 | 19.31 | 101.97 | 83.20 | 148.55 | 872.34 | 3382.91 |
| Total | 7335.49 | 1475.74 | 557.58 | 637.27 | 404.11 | 100.94 | 531.62 | 427.29 | 1183.17 | 4230.32 | 16883.52 |

Table 4:30

Total Expenditures by Major Category
FEP Case
($ Millions Cdn. 1981)

| Year | Rigs | Supply Boats | Heli-copters | Total Fuel | Mud | Cement | Casing | Logging | Seismic | Other | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1981 | 130.74 | 28.30 | 10.11 | 14.51 | 6.79 | 2.14 | 11.22 | 9.10 | 21.00 | 78.50 | 312.40 |
| 1982 | 140.45 | 29.92 | 11.09 | 15.86 | 7.12 | 2.17 | 11.39 | 9.45 | 21.00 | 83.89 | 332.33 |
| 1983 | 93.67 | 19.68 | 7.00 | 8.41 | 5.57 | 1.43 | 7.60 | 6.10 | 26.25 | 54.98 | 230.70 |
| 1984 | 108.46 | 22.19 | 8.45 | 10.49 | 6.36 | 1.55 | 8.18 | 6.76 | 26.25 | 63.48 | 262.17 |
| 1985 | 81.52 | 16.80 | 6.18 | 7.71 | 4.70 | 1.20 | 6.36 | 5.03 | 26.25 | 47.61 | 203.36 |
| 1986 | 86.49 | 18.09 | 6.37 | 8.12 | 4.27 | 1.21 | 6.37 | 5.31 | 31.50 | 50.04 | 217.77 |
| 1987 | 89.91 | 18.92 | 6.29 | 7.55 | 4.61 | 1.24 | 6.52 | 5.46 | 31.50 | 51.63 | 223.64 |
| 1988 | 88.49 | 17.67 | 6.51 | 7.63 | 4.36 | 1.18 | 6.19 | 5.01 | 26.25 | 50.41 | 213.70 |
| 1989 | 103.55 | 20.46 | 7.85 | 10.61 | 4.55 | 1.29 | 6.78 | 5.70 | 26.25 | 59.20 | 246.23 |
| 1990 | 80.64 | 17.06 | 5.62 | 6.92 | 3.92 | 1.11 | 5.86 | 4.66 | 21.00 | 46.31 | 193.10 |
| Total | 1003.93 | 209.07 | 75.47 | 97.80 | 52.25 | 14.53 | 76.48 | 62.58 | 257.25 | 586.05 | 2435.41 |

Table 4:31

Total Expenditures by Major Category
Low Case
($ Millions Cdn. 1981)

| Year | Rigs | Supply Boats | Heli-copters | Total Fuel | Mud | Cement | Casing | Logging | Seismic | Other | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1981 | 149.73 | 32.24 | 11.56 | 17.03 | 7.97 | 2.52 | 13.13 | 10.37 | 31.50 | 90.08 | 366.12 |
| 1982 | 199.51 | 42.91 | 15.51 | 21.41 | 10.39 | 3.18 | 16.68 | 13.55 | 31.50 | 119.17 | 473.80 |
| 1983 | 223.74 | 46.40 | 17.45 | 22.27 | 12.55 | 3.38 | 17.82 | 14.39 | 44.10 | 131.92 | 534.01 |
| 1984 | 219.69 | 44.38 | 17.50 | 21.52 | 12.51 | 3.24 | 16.99 | 13.52 | 44.10 | 128.72 | 522.16 |
| 1985 | 265.33 | 53.31 | 20.37 | 23.57 | 13.80 | 3.64 | 19.18 | 15.95 | 54.60 | 152.96 | 622.72 |
| 1986 | 260.10 | 50.79 | 20.85 | 26.87 | 13.62 | 3.50 | 18.41 | 14.92 | 63.00 | 150.62 | 622.69 |
| 1987 | 267.45 | 54.81 | 20.09 | 25.97 | 13.80 | 3.72 | 19.59 | 15.82 | 63.00 | 155.14 | 639.39 |
| 1988 | 254.72 | 51.89 | 18.62 | 20.54 | 13.32 | 3.45 | 18.20 | 14.71 | 54.60 | 145.71 | 595.76 |
| 1989 | 277.77 | 55.96 | 20.55 | 23.45 | 14.66 | 3.75 | 19.75 | 15.58 | 54.60 | 159.04 | 645.10 |
| 1990 | 309.78 | 62.80 | 22.71 | 25.68 | 15.59 | 4.05 | 21.25 | 17.17 | 42.00 | 176.79 | 697.84 |
| Total | 2427.82 | 495.50 | 185.21 | 228.32 | 128.20 | 34.42 | 180.98 | 145.99 | 483.00 | 1409.15 | 5719.60 |

Table 4:32

Total Expenditures by Major Category
High Case
($ Millions Cdn. 1981)

| Year | Rigs | Supply Boats | Heli-copters | Total Fuel | Mud | Cement | Casing | Logging | Seismic | Other | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1981 | 195.22 | 41.42 | 15.40 | 22.85 | 10.30 | 3.32 | 17.27 | 13.32 | 42.00 | 117.53 | 478.63 |
| 1982 | 304.60 | 65.11 | 23.30 | 30.72 | 16.43 | 4.83 | 25.39 | 20.56 | 42.00 | 181.12 | 714.06 |
| 1983 | 352.68 | 71.73 | 27.95 | 34.20 | 19.18 | 5.18 | 27.27 | 22.25 | 63.00 | 206.59 | 830.03 |
| 1984 | 419.24 | 83.99 | 33.89 | 42.54 | 23.25 | 6.00 | 31.62 | 25.59 | 63.00 | 245.71 | 974.83 |
| 1985 | 449.22 | 90.39 | 34.96 | 42.87 | 24.16 | 6.33 | 33.34 | 27.05 | 84.00 | 261.09 | 1053.42 |
| 1986 | 431.97 | 87.69 | 33.47 | 38.65 | 24.24 | 6.07 | 31.99 | 25.77 | 94.50 | 250.45 | 1024.79 |
| 1987 | 528.47 | 106.06 | 41.16 | 48.99 | 27.30 | 6.99 | 36.89 | 30.61 | 94.50 | 304.72 | 1225.69 |
| 1988 | 472.41 | 94.91 | 35.57 | 39.86 | 27.16 | 6.65 | 35.05 | 26.90 | 84.00 | 272.31 | 1094.83 |
| 1989 | 498.64 | 99.58 | 36.21 | 37.40 | 27.81 | 6.69 | 35.17 | 27.72 | 84.00 | 283.69 | 1136.93 |
| 1990 | 653.70 | 129.04 | 47.78 | 47.90 | 36.58 | 8.19 | 43.24 | 35.28 | 63.00 | 369.96 | 1434.70 |
| Total | 4306.17 | 869.90 | 329.70 | 386.00 | 236.42 | 60.26 | 317.23 | 255.05 | 714.00 | 2493.17 | 9967.89 |

the helicopters.

The expenditures associated with drilling fluid additives depend on the requirements for barite, bentonite and other additives and their respective costs. The requirements of barite, bentonite and other additives are a function of the depth of the well and the downhole characteristics.

The expenditures on casing and cement are calculated by multiplying the number of tonnes of each by their respective cost per tonne. An additional amount is added for specific services associated with each.

Electric logging refers to the application of geophysical techniques to the borehole. The logs describe hole characteristics and are invaluable to geologists and drilling engineers. Electric logging costs are dependant upon the required number of open hole and cased hole electric logging jobs.

The 'other' category represents an aggregation of all miscellaneous goods and services provided in connection with exploration activities. Individually, these items are insignificant in cost; however, in total, they represent approximately 25 percent of total expenditures.

## 5. Current State of the Provincial Share

### 5.1 Overview

Not all the activity taking place in the offshore area of the province will affect the provincial economy. Many expenditures will have no local impact, while others will be totally local. The Department of Development and the Department of Labor and Manpower have been actively monitoring and collecting information relating to the provincial content in terms of the provision of goods and services and the local employment resulting from the offshore exploration activity. This chapter analyzes the current state of the provincial share from information available to us. The analysis is based upon data for 1979 and 1980. Where information for 1981 is available, it was also used.

Tables 5:1 and 5:2 give the drilling report for 1979 and 1980, respectively. For each well drilled, these tables show the name of the operator, the spud date, the drilling unit employed, the water depth, the total well depth, the rig release date and the current status of the well. In all, there were eight wells worked on in 1979 and twelve in 1980.

### 5.2 Goods and Services

The exploration and development of our offshore petroleum resources offers the Newfoundland and Labrador business community a new opportunity to expand their present product and service lines and to offer new ones. Many new business services and products will be required by the oil industry and, therefore, new businesses have been, and will be, established to meet this demand. For example, since the discovery of the Hibernia field in the fall of 1979, some 90 new businesses have incorporated in Newfoundland largely or wholly supported by offshore exploration activity. In addition to the new businesses, many existing companies have expanded their product mix to provide goods and services to the offshore industry. Some new products include safety equipment, downhole tools, rock bits and miscellaneous oilfield and related equipment. New services offered by the Newfoundland and Labrador business community include diving, engineering, geological and environmental consulting, supply base facilities and services, weather forecasting, remote services and ice observation.

The latest available statistics (1979) show that 70 percent of the value of all goods and services is provided by either Newfoundland owned companies or companies operating from branch offices within the province. Table 5:3 shows the breakdown of the supply of goods and service by company type.

Company Type A: Companies incorporated in the province with at least 51 percent of the shares held and beneficially owned by persons normally resident in the province.

Company Type B: Companies whose business is conducted and managed in the province and most of whose employees are normally resident in the province.

Company Type C: All other companies.

Some services presented in Table 5:3 have changed drastically since 1979. For example, neither cement nor drilling fluid additives are now supplied by type 'C' companies.

### 5.3 Employment

Since industry's acceptance of the Newfoundland and Labrador Petroleum Regulations (1977) the provincial labor force has enjoyed a continually increasing participation rate in offshore exploration activities. From

Table 5:1

Drilling Report For 1979

| Well Name | Spud date | Drilling Unit | Water Depth (m) | Total Depth (m) | Rig Release | Status |
|---|---|---|---|---|---|---|
| **Grand Banks Area** | | | | | | |
| Esso Voyager Gabriel C-60 | 79 05 06 | Sedco 709 | 1109 | 5171 | 79 12 18 | Abandoned |
| Chevron et al Hibernia P-15 | 79 05 27 | Glormar Atl. Zapata Ug. | 80 | 4407 | 79 08 26 | Suspended |
| **Northeast Nfld** | | | | | | |
| Texaco-Shell et al Blue H-28 | 79 04 28 | Discoverer Seven Seas | 1486 | 6103 | 79 08 26 | Abandoned |
| BP et al Hare Bay E-21 | 79 06 14 | Sedco 707 | 263 | 4874 | 79 10 18 | Abandoned |
| **Labrador Margin** | | | | | | |
| Eastcan et al Roberval K-92 | 78 10 02 | Pelerin | 268.5 | 3874 | 78 10 27 | Suspended |
| Eastcan et al Bjarni O-82 | 79 07 29 | Petrel | 143 | 2650 | 79 10 22<br>80 10 19 | Suspended |
| Eastcan et al Tyrk P-100 | 79 07 29 | Pelican | 117 | 1739 | 79 08 26 | Abandoned |
| Eastcan et al Gilbert F-53 | 79 09 10 | Pelican | 183 | 3608 | 79 10 15<br>80 09 12 | Abandoned |

Table 5:2

Drilling Report For 1980

| Well Name | Spud date | Drilling Unit | Water Depth (m) | Total Depth (m) | Rig Release | Status |
|---|---|---|---|---|---|---|
| Grand Banks Area | | | | | | |
| Chevron et al Hibernia P-15 | 79 05 27 | Glormar Atl. /Zapata Ug. | 80 | 4407 | 80 01 07 | Suspended |
| Mobil et al Hibernia 0-35 | 80 01 01 | Sedco 709 | 80 | 4788.5 | 80 07 13 | Suspended |
| Mobil et al Ben Nevis I-45 | 80 01 10 | Zapata Ug. | 98 | 4933 | 80 09 09 | Suspended |
| Mobil et al Hibernia B-08 | 80 03 13 | Sedco 706 | 83 | 4436 | 80 01 06 | Suspended |
| Mobil et al South Tempest G-88 | 80 09 16 | Zapata Ug. | 56 | - | | Testing |
| Mobil et al Hibernia G-55A | 80 12 11 | Ocean Ranger | 78 | 3460 | 81 02 20 | Abandoned |
| Labrador Margin | | | | | | |
| Petro-Canada et al Gilbert F-53 | 79 09 10 | Pelican | 183 | 3608 | 79 10 15 | Abandoned 80 09 12 |
| Petro-Canada et al Roberval C-02 | 80 07 05 | Neddrill 2 | 278 | 2823 | 80 09 14 | Abandoned |
| Chevron et al South Labrador N-79 | 80 08 02 | Glomar At. | 500 | 3572 | 80 10 18 | Suspended |
| Petro-Canada et al Ogmund E-72 | 80 08 16 | Pelerin | 157 | 3094 | 80 10 08 | Abandoned |
| Petro-Canada et al North Leif I-05 | 80 09 14 | Pelican | 146 | 423 | 80 09 27 | Suspended |
| Petro-Canada et al North Bjarni F-06 | 80 09 27 | Pelican | 170 | 423 | 80 10 07 | Suspended |

Table 5:3

Supply of Goods and Services
by Company Type - 1979
(% of Total Expenditures)

| Category | Company Type A | B | C | Total |
|---|---|---|---|---|
| Drilling Rig | - | 44.0 | - | 44.0 |
| Supply Boat | 0.1 | 9.5 | - | 9.6 |
| Helicopter | - | 4.3 | 0.2 | 4.5 |
| Seismic | - | - | 1.2 | 1.2 |
| Fuel | - | 2.5 | 2.2 | 4.7 |
| Drilling Fluids | - | 2.4 | 1.8 | 4.2 |
| Cement & Service | - | 0.2 | 0.4 | 0.6 |
| Casing | - | - | 4.8 | 2.5 |
| Logging | - | - | 2.5 | 2.5 |
| Other | 5.7 | 1.4 | 16.8 | 23.9 |
| Total | 5.8 | 64.3 | 29.9 | 100.0 |

May, 1979 to February, 1981, the percentage of Newfoundland and Labrador labour employed directly in offshore operations increased from 32 percent to 67 percent. Many of the top positions, however, have yet to be occupied by local labour. Table 5:4 provides a breakdown of the participation rates of residents by employment category as of February, 1981.

When considering year round drilling operations, Table 5:4 gives a fairly reliable estimate of local labor content. Seasonal operations have a lesser local participation rate

Table 5.4

Local Labor Participation Rate
February, 1981
(%)

| Job Category | Local Labor |
|---|---|
| Drilling Crews | 62.5 |
| Support Staff | 70.7 |
| Marine Crews | 70.6 |
| Onshore Operations | 68.4 |
| Seismic Operations | 55.4 |

due to the unavailability of qualified persons to work for a four month period. Exploration activity in the Newfoundland and Labrador offshore area has a significant degree of seasonality associated with it and this is likely to continue over the next decade. The local labor content

Table 5:5

Local Labor Participation Rate
(Estimated Average 1981)
(%)

| Job Category | Local Labor |
|---|---|
| Drilling Crew | 55 |
| Support Staff | 65 |
| Marine Crew | 65 |
| Onshore Operation | 65 |
| Seismic | 50 |

of Table 5:4, therefore, should be deflated by a factor which accounts for the seasonality of offshore drilling. Table 5:5 is an estimate of the 1981 provincial labor participation rate as a percentage of manyears of employment by major job category.

## 5.4 Direct Impact

### 5.4.1 Definition of Direct Impact

For the purposes of this study the direct impact as a result of the expenditures by the petroleum industry in any particular year on the province is defined as including the following:

1. Wages and salaries to residents of the province, and including other direct income to residents of the province (bonuses, etc.).

2. Other benefits to the province, including:

A) the 'corrected' expenditures made by type 'A' and type 'B' companies to other permanent establishments in the province, to residents and to the provincial or municipal governments, to the extent such expenditures can be allocated to the petroleum expenditures made during the year in consideration, and including the following:

(a) taxes, fees or levies,
(b) operating costs,
(c) equipment and other capital, and
(d) interest;

B) the share of profits made by type 'A' and type 'B' companies belonging to residents of the province, and excluding the following;

(a) payments made to type 'C' companies net of wages, salaries

and other income to residents of the province; and

(b) the 'corrected' expenditures made by type 'A' and 'B' companies to any company or person outside the province.

In this definition, the word 'corrected' means that where expenditures by type 'A' and type 'B' companies were made to other companies and these expenditures did not reflect payments that would accrue to the province, such expenditures were corrected downwards to reflect the amount that would accrue to the province in such a second cycle of expenditures.

5.4.2 Present Direct Impact

The direct impact from wages and salaries can be estimated using the wage by occupation and the number of residents employed. Table 5:6 gives the participation rate for provincial residents by job grouping.'Resident' is defined as a person whose permanent residence is within the province. The term 'resident' has a wider meaning than does the term 'local labor force' and includes those, who because of their employment in the offshore, move to the province and take up residence. For purposes of measuring direct impact, the two cannot be separated.

Table 5:7, presents other benefits as a percentage of contract value.

Using the data from Tables 5:6 and 5:7, the total direct impact for all future exploration programs can be estimated.

Table 5:6

Employment Participation
Residents of the Province
(1981)

| Category | (%) of Employees |
|---|---|
| Drilling Crew | 65 |
| Support Staff | 75 |
| Marine Crew | 75 |
| Onshore Operations | 95 |
| Seismic | 60 |

Table 5:7

Direct Impact of Other Benefits
(1979)

| Category | (%) of Contract Value |
|---|---|
| Drilling Rig | 2 |
| Supply Boat | 3 |
| Helicopter | 15 |
| Fuel | 8 |
| Drilling Mud | 3 |
| Cement | 4 |
| Casing | 1 |
| Logging | 3 |
| Seismic | 5 |
| Other | 10 |

## 6. Future Share by the Provincial Economy

### 6.1 Factors Influencing the Future Share

There are many factors influencing the degree to which the province shares in the offshore exploration activity. In the past, the erratic level of exploration, the seasonal nature of the activity, the low level of demand, etc. were negative factors to the province attaining a larger share. Many of these negative factors, however, have now disappeared or at least significantly lessened. There has now been continuous drilling on the Grand Banks since May 1979. Sectors of the service and supply industry that in the past were not considered good opportunities because of low volume or a high degree of seasonality, may now be reaching the level necessary to sustain local involvement. In addition, the development of fields such as Hibernia will certainly increase the demand for offshore related goods and services and, hence, add to the demand created by the exploration phase.

The future share of exploration activity will depend heavily on our ability to respond to the opportunities provided. In examining the future share by the provincial economy and the methods by which it can be increased, let us first look at those areas that can impact individually on the total picture.

The direct impact on the province can be increased in many ways. Several of these ways are listed below.

(1) by increasing the number of provincially owned companies;

(2) by increasing the ability of the province to supply goods and services to the petroleum industry;

(3) by increasing the participation of residents of the province in the labour force; and

(4) by increasing the ability of the province to provide support to the petroleum industry.

It is likely that the direct impact in the coming decade on the province will increase through all of these processes. Let us look briefly at each.

#### 6.1.1 Increasing Provincially Owned Companies

The level of locally owned and controlled companies (type 'A' companies) supplying offshore requirements for goods and services is still very low. The procurement practices of the oil industry favor large established organizations with proven track records. This consequently makes it extremely difficult for new organizations to break into the market, especially if these organizations are small and located away from the operating company's purchasing centre. Even in Norway and the United Kingdom, it has been difficult to break this closed system*. The province's approach to this problem is addressed in Regulations 124-129 requiring permittees, their contractors, and subcontractors to give preference to local companies in the procurement of goods and services where competitive in terms of fair market price, quality and delivery. Coupled with this, Sections 120-123 of the regulations require the expenditure by permittees on petroleum related education and training (E & T) and research and development (R & D) programs in the province.

Of the major categories of expenditures on offshore exploration

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* Bjartmar Gjerde, Minister, Royal Norwegian Ministry of Petroleum and Energy Speech to Offshore North Sea Conference, Stavanger, August 26, 1980.

dealt with in Chapter 4, there are a number of areas where opportunities for increasing participation by locally owned companies exist.

Expenditure on rig rentals constitutes the largest single cost item. Local ownership of drilling rigs would, therefore, be a major avenue for increasing local participation in offshore exploration activity. Following rigs, the next major item of expenditure is for supply boats. Table 4:2 and 4:6 clearly indicate that on the basis of the expected exploration activity alone (not taking Hibernia development into account), the existence of locally owned drilling rigs and supply boats could be easily justified. The local ownership of supply boats and drilling rigs would significantly increase the benefits that the province might obtain from offshore exploration activitites. In addition, supply boats and drilling rigs could be used during the development of Hibernia and other petroleum fields as well as during the production phase. As a consequence there is the very real possibility of a 30 year market for these items. Few of the supply boats operating in our waters in the last ten years have been owned by Canadians or registered in Canada. The anticipated rate of activity certainly means that Newfoundland and other Canadian ownership should be encouraged. Since none of the drilling rigs now working off our coast are owned by local or Canadian companies and since there will probably be a severe shortage of the right kinds of rigs to operate in our waters for several years to come, we should seriously consider the feasibility of increased provincial participation through locally owned drilling rigs. Whether local ownership would be profitable or desirable is a matter beyond the scope of this report. It should be stressed, however, that local ownership of supply boats and rigs would increase the value added of petroleum expenditures to the province and this would be true whether this equipment were to be constructed in the province or not.

Services such as helicopters, diving, pipe inspection, well site surveying, catering, etc. are increasingly being offered by local firms either on their own or through joint ventures. Engineering and scientific services, weather forecasting, iceberg profiling and site surveying, for example, are already well represented by locally owned firms. The requirements for data processing also presents a substantial opportunity for investment by local companies. As local firms gain experience and competence, one can expect an eventual dominance in such categories by local businesses.

6.1.2 Increasing Provincially Supplied Goods and Services

Another aspect of exploration expenditures that offers opportunities for increased participation by companies resident in the province would be the supply of drilling fluid additives and cement. This would be true whether the companies were locally owned or not. Deposits of barite are present at Buchans and Colliers and the quantities seem to indicate Newfoundland could be self-sufficient for some time to come. Other drilling fluid additives are required in relatively small quantities and are not likely to be produced locally.

Significant deposits of limestone exist on the west coast of the island. The local manufacture of oil well cement will require significantly higher annual drilling rates than at present to insure the feasibility of adapting present cement manufacturing facilities to produce oil well grade cement.

Fuel, which represents about 5% of all drilling costs could, with the reactivation of Come-By-Chance, be

supplied entirely from within the province.

It should be noted here that companies supplying goods in this category such as barite, other drilling fluid additives, cement, and fuel, although resident in the province, may not necessarily be locally owned. Petro-Canada, for example, has an option to purchase the Come By Chance oil refinery while deposits of barite at Buchans are owned by Asarco Inc. Price (NFLD) Ltd.

6.1.3 Increasing Provincial Participation in the Labour Force

At present, income to local residents of the province from employment in the exploration activities offshore constitutes the largest percentage contribution to the total direct impact resulting from offshore exploration. In fact up to now, the impact of employment in the exploration activity was greater than all other benefits flowing to the province combined. This situation may be expected to change as the province's business community increases its supply of goods and services to the offshore exploration activities. The current balance, however, cannot be expected to change drastically. Undoubtedly, income to residents of the province will continue to be large and account for a significant portion of the total impact.

The participation rate of local labour as a percentage of total labour directly employed in the offshore exploration activity is already high for many categories. Referring back to Table 5:4, the percentage participation ranges from 55% in the case of seismic operations, to 71% in the case of support staff. It is an objective to continue to increase this participation rate by expanding into increasingly more responsible jobs in the offshore. The degree to which this will be possible will depend largely on the success of manpower and training programs and the experience gained by on-the-job training programs. Based on Section 5:3 , opportunities to increase the provincial component exist in all categories. The specialized services employment categories such as electric logging, cementing, drilling fluid, engineering and environmental consulting, production testing and directional drilling offer some of the more promising opportunities.There is also an opportunity to move local talent into supervisory and management positions.

6.1.4 Increasing Support Activities and Other Indirect Benefits

While this report primarily deals with direct impact of exploration, it may be interesting to include here a brief overview of several exploration support and other related activities which individually and together may impact greatly on the province. It should be noted, however, that these and other indirect impacts will be dealt with more extensively in later reports.

Exploration activity offshore will foster the growth and establishment of local support activities with long term, ongoing capabilities to meet the needs of the petroleum industry in both the domestic and world markets.

The first and probably the most obvious area of possible industrial expansion would be the building of drilling rigs, supply boats and seismic boats in the province. Drilling rig construction and shipbuilding, as a high industrial priority, would meet many of the objectives of servicing a heavy industry base, earning foreign exchange, meeting domestic demand and securing a position in the international marketplace. The question of whether rig construction situated in the province can be economically competitive has yet to be

answered. At first glance, for example, it is thought that a yard designed to build drilling rigs would have to be sufficiently flexible to build floating production platforms to maintain the yard's viability.

The provision of infrastructure for transport and transhipment services, (sea and air) will lead to new port and supply base development and could thereby avoid conflict between traditional and oil related use of piers and harbours. Action has already been taken to protect existing land uses and to reserve land for future industrial infrastructure developments. A large portion of expenditures unclassified in Tables 4:29-4:34 includes services centered around a supply base such as catering, pipe coating, pollution control, electronic instrument services, surveying, etc. Increased exploration activity offshore Labrador and in the Eastern Artic will lead to increased cargo tonnages of equipment and materials to be moved within a relatively short shipping season. This activity would use island-based transhipment ports which could also support hydro, mining and other resource development projects. The projected level of exploration dictates the need for serious examination of the feasibility of establishing a transhipment base with its inherent advantage to provincially-based shippers. Progressive increases in the capability of provincially-based shipping firms servicing exploration needs could greatly increase their participation in Northern and Artic marine transport.

Education and training (E & T) and research and development (R & D) undertaken in the province is of crucial importance in developing a long term base in the province. The stimulation of selected areas of technology, experience in offshore engineering and construction, expansion of manufacturing capabilities, and the application of technology pioneered offshore Newfoundland and Labrador are direct benefits supported by the E & T and R & D obligations of offshore operators. Local institutions, such as C-Core (Centre for Cold Oceans Research Engineering), and NORDCO - (Newfoundland Ocean Research and Development Corporation),are prime examples of our establishment of select international competence in offshore R & D.

6.2 Estimation of the Future Direct Impact

Depending upon the outcome of factors influencing the level of exploration and the success of the provincial economy in sharing in the activity, it is clear that the direct impact could vary considerably.

Table 6:1 gives estimates of the range of the possible provincial share of 'other benefits' in terms of a low, medium and high by the end of the forecast period (1990). The same definition given 'other benefits' in Section 5:4:1 applies here. The high estimate represents the case where locally owned companies providing goods and services with high provincial value added components have developed strongly, and where the level of activity is sufficiently high

Table 6:1

Direct Impact of Other Benefits (1990)

| | % of Total Expenditure | | |
|---|---|---|---|
| Catagory | Low | Medium | High |
| Drilling Rig | 2 | 5 | 10 |
| Supply Boat | 5 | 10 | 15 |
| Helocopter | 10 | 15 | 15 |
| Fuel | 8 | 8 | 50 |
| Drilling Fluid | 5 | 15 | 25 |
| Cement | 4 | 8 | 30 |
| Casing | 1 | 1 | 2 |
| Logging | 3 | 5 | 8 |
| Seismic | 7 | 12 | 15 |
| Other | 10 | 15 | 20 |

to sustain such a high provincial content. The medium and low estimates represent relatively lower stages of provincial offshore goods and services supply sector development.

Table 6:2 gives estimates of the percentage participation by residents of the province in the labour force employed directly in the exploration activities by the end of the forecast period (1990). As in the case of 'other benefits', a high, medium and low estimate is given to provide a range of possible outcomes.

We expect that the actual outcome in terms of the extent to which the province will share in the exploration activity will occur somewhere within the range given by the low, medium and high estimate. Furthermore, the actual outcome is directly related to the level of exploration activity occurring in any given year. It is, therefore, interesting to combine the forecast of exploration activity, namely, FEP, low and high, with that of the three provincial content estimates. Table 6:3 shows how the forecast of exploration activity may be combined with the forecast of provincial content to create nine scenarios.

Table 6:2

Employment Participation by Local Residents of the Province (1990)

| Catagory | % of Employees | | |
|---|---|---|---|
| | Low | Medium | High |
| Drilling Crew | 70 | 80 | 90 |
| Support Staff | 70 | 80 | 90 |
| Marine Crew | 70 | 80 | 90 |
| Onshore Operations | 95 | 95 | 95 |
| D.P. Operations | 30 | 50 | 80 |
| Seismic | 60 | 70 | 80 |

Referring to Table 6:3, the FEP-low case is unlikely to occur. If exploration continues, but at a low level, it will be relatively easy to rapidly increase participation. As a consequence, the FEP-medium and FEP-high scenarios are most likely to occur.

Table 6:3

Direct Impact Scenarios

| Explor. Activity | Provincial Content | | |
|---|---|---|---|
| | Low | Medium | High |
| FEP | FEP-Low | FEP-Med | FEP-High |
| LOW | LOW-Low | LOW-Med | LOW-High |
| HIGH | HIGH-Low | HIGH-Med | HIGH-High |

The high-high scenario is equally unlikely to occur. If exploration returns to it pre FEP acceleration pace, then it will be unlikely that the province will be able to keep pace with the demands. As a result, the high-medium or the high-low scenarios are probably the more realistic expectations.

In veiw of the current federal energy policy, all high exploration scenarios are unlikely to occur.

The most realistic range, therefore, for the direct impacts on the province is represented by the FEP-medium and low-high scenarios. The FEP-high, low-low and low-medium scenarios fall in this range.

Tables 6:4, 6:5 and 6:6 present an estimate of the direct economic impact, in terms of wages and salaries and all other expenditures, of petroleum exploration activity on the province. For comparison purposes columns showing the total exploration activity expenditures and the total expenditures to provincially based companies are also included.

Tables 6:7, 6.8 and 6:9 give the direct economic impact as a percentage of total expenditure. As in the case with tables 6:4, 6:5 and 6:6 these tables deal with the FEP-Medium and the Low-Medium and the Low-High cases, respectively.

Table 6:4

Direct Economic Impact
FEP-Medium Case
($ 1981 Cdn. Millions)

| Year | Total Expen. | Direct Impact: Wages & Salaries | Direct Impact: All Other Expen. | Direct Impact: Total | Expenditures To Provincially Based Companies |
|---|---|---|---|---|---|
| 1981 | 312 | 19 | 17 | 36 | 225 |
| 1982 | 332 | 21 | 18 | 39 | 246 |
| 1983 | 231 | 15 | 14 | 29 | 176 |
| 1984 | 262 | 17 | 16 | 33 | 204 |
| 1985 | 203 | 14 | 14 | 28 | 162 |
| 1986 | 218 | 15 | 15 | 30 | 178 |
| 1987 | 224 | 15 | 16 | 31 | 188 |
| 1988 | 214 | 14 | 17 | 32 | 184 |
| 1989 | 246 | 16 | 21 | 37 | 216 |
| 1990 | 193 | 13 | 16 | 29 | 174 |
| Total | 2435 | 160 | 164 | 324 | 1953 |

Table 6:5

Direct Economic Impact
Low-Medium Case
($ 1981 Cdn. Millions)

| Year | Total Expen. | Direct Impact: Wages & Salaries | Direct Impact: All Other Expen. | Direct Impact: Total | Expenditures To Provincially Based Companies |
|---|---|---|---|---|---|
| 1981 | 366 | 22 | 20 | 42 | 263 |
| 1982 | 474 | 30 | 26 | 55 | 351 |
| 1983 | 534 | 33 | 32 | 65 | 406 |
| 1984 | 522 | 32 | 32 | 64 | 407 |
| 1985 | 623 | 37 | 42 | 79 | 498 |
| 1986 | 623 | 38 | 43 | 81 | 511 |
| 1987 | 639 | 39 | 45 | 84 | 536 |
| 1988 | 596 | 37 | 49 | 86 | 597 |
| 1989 | 645 | 39 | 54 | 93 | 568 |
| 1990 | 698 | 42 | 59 | 101 | 628 |
| Total | 5720 | 349 | 402 | 941 | 4765 |

Table 6:6

Direct Economic Impact
Low-High Case
($ 1981 Cdn. Millions)

| Year | Total Expen. | Direct Impact: Wages & Salaries | Direct Impact: All Other Expen. | Direct Impact: Total | Expenditures To Provincially Based Companies |
|---|---|---|---|---|---|
| 1981 | 366 | 22 | 20 | 42 | 263 |
| 1982 | 474 | 30 | 27 | 57 | 351 |
| 1983 | 534 | 34 | 34 | 69 | 406 |
| 1984 | 522 | 34 | 41 | 75 | 407 |
| 1985 | 623 | 39 | 52 | 92 | 498 |
| 1986 | 623 | 41 | 62 | 103 | 511 |
| 1987 | 639 | 43 | 67 | 109 | 536 |
| 1988 | 596 | 40 | 79 | 119 | 597 |
| 1989 | 645 | 43 | 89 | 132 | 568 |
| 1990 | 698 | 46 | 99 | 145 | 628 |
| Total | 5720 | 372 | 570 | 941 | 4765 |

Table 6.7

Direct Impact as a Percentage of Total Expenditures FEP-Medium Case

| Year | Wages & Salaries | Other Benefits | Totals |
|---|---|---|---|
| 1981 | 6.1 | 5.4 | 11.5 |
| 1982 | 6.2 | 5.4 | 11.6 |
| 1983 | 6.6 | 6.1 | 12.7 |
| 1984 | 6.7 | 6.1 | 12.8 |
| 1985 | 7.0 | 6.7 | 13.7 |
| 1986 | 7.0 | 6.9 | 13.9 |
| 1987 | 6.6 | 7.1 | 13.7 |
| 1988 | 6.6 | 8.2 | 14.8 |
| 1989 | 6.4 | 8.4 | 14.8 |
| 1990 | 6.8 | 8.4 | 15.2 |

Table 6.8

Direct Impact as a Percentage of Total Expenditures Low-Medium Case

| Year | Wages & Salaries | Other Benefits | Totals |
|---|---|---|---|
| 1981 | 6.0 | 5.4 | 11.4 |
| 1982 | 6.2 | 5.4 | 11.6 |
| 1983 | 6.3 | 6.0 | 12.3 |
| 1984 | 6.1 | 6.1 | 12.2 |
| 1985 | 6.0 | 6.7 | 12.7 |
| 1986 | 6.0 | 6.9 | 12.9 |
| 1987 | 6.1 | 7.1 | 13.2 |
| 1988 | 6.2 | 8.1 | 14.3 |
| 1989 | 6.1 | 8.4 | 14.5 |
| 1990 | 6.0 | 8.4 | 14.4 |

Table 6.9

Direct Impact as a Percentage of Total Expenditures Low-High Case

| Year | Wages & Salaries | Other Benefits | Totals |
|---|---|---|---|
| 1981 | 6.0 | 5.5 | 11.5 |
| 1982 | 6.3 | 5.7 | 12.0 |
| 1983 | 6.4 | 6.4 | 12.8 |
| 1984 | 6.5 | 7.9 | 14.3 |
| 1985 | 6.3 | 8.3 | 14.7 |
| 1986 | 6.6 | 10.0 | 16.5 |
| 1987 | 6.7 | 10.5 | 17.1 |
| 1988 | 6.7 | 13.3 | 20.0 |
| 1989 | 6.7 | 13.8 | 20.5 |
| 1990 | 6.6 | 14.2 | 20.8 |

Tables 6:10, 6:11 and 6:12 show the provincial content of wages and salaries as a percent of total wages and salaries and the provincial content of all other expenditures as a percent of the total of all other expenditures, for the FEP-Medium, the Low-Medium and the Low-High cases, respectively.

The FEP-Medium and low-high scenarios represent a realistic range for the direct impacts on the province. The Low-Medium is included also and represents that which is most likely to occur.

Table 6:13, 6:14 and 6:15 provide peak employment by major categories of residents of the province for the FEP-Medium, low-medium and low-high, scenarios, respectively.

Table 6:10

Direct Economic Impact
FEP-Medium Case
($ 1981 Cdn. Millions)

| | Wages & Salaries | | | All Other Expenditures | | |
|---|---|---|---|---|---|---|
| Year | Total | Prov. Content | % | Total | Prov. Content | % |
| 1981 | 26 | 19 | 74 | 286 | 17 | 6 |
| 1982 | 28 | 21 | 74 | 305 | 18 | 6 |
| 1983 | 20 | 15 | 76 | 211 | 14 | 7 |
| 1984 | 23 | 17 | 76 | 239 | 16 | 7 |
| 1985 | 18 | 14 | 77 | 185 | 14 | 7 |
| 1986 | 20 | 15 | 78 | 198 | 15 | 8 |
| 1987 | 19 | 15 | 78 | 205 | 16 | 8 |
| 1988 | 18 | 14 | 80 | 196 | 17 | 9 |
| 1989 | 20 | 16 | 81 | 227 | 21 | 9 |
| 1990 | 16 | 13 | 82 | 177 | 16 | 9 |
| Total | 207 | 160 | 77 | 2228 | 164 | 7 |

Table 6:11

Direct Economic Impact
Low-Medium Case
($ 1981 Cdn. Millions)

| | Wages & Salaries | | | All Other Expenditures | | |
|---|---|---|---|---|---|---|
| Year | Total | Prov. Content | % | Total | Prov. Content | % |
| 1981 | 30 | 22 | 73 | 336 | 20 | 6 |
| 1982 | 40 | 29 | 74 | 434 | 26 | 6 |
| 1983 | 44 | 33 | 75 | 490 | 32 | 7 |
| 1984 | 42 | 34 | 75 | 480 | 32 | 7 |
| 1985 | 50 | 37 | 75 | 573 | 42 | 7 |
| 1986 | 49 | 38 | 76 | 574 | 45 | 7 |
| 1987 | 51 | 39 | 77 | 589 | 49 | 8 |
| 1988 | 46 | 37 | 79 | 549 | 52 | 9 |
| 1989 | 49 | 39 | 81 | 596 | 54 | 9 |
| 1990 | 51 | 42 | 81 | 647 | 59 | 9 |
| TOTAL | 452 | 349 | 77 | 5268 | 401 | 8 |

Table 6:12

Direct Economic Impact
Low-High Case
($ 1981 Cdn. Millions)

| | Wages & Salaries | | | All Other Expenditures | | |
|---|---|---|---|---|---|---|
| Year | Total | Prov. Content | % | Total | Prov. Content | % |
| 1981 | 30 | 22 | 73 | 336 | 20 | 6 |
| 1982 | 40 | 30 | 76 | 434 | 27 | 6 |
| 1983 | 44 | 34 | 78 | 490 | 34 | 7 |
| 1984 | 42 | 34 | 79 | 480 | 41 | 9 |
| 1985 | 50 | 39 | 79 | 573 | 52 | 9 |
| 1986 | 49 | 41 | 83 | 574 | 62 | 11 |
| 1987 | 51 | 43 | 84 | 589 | 67 | 11 |
| 1988 | 46 | 40 | 86 | 549 | 79 | 14 |
| 1989 | 49 | 43 | 88 | 596 | 89 | 15 |
| 1990 | 51 | 46 | 90 | 647 | 99 | 15 |
| TOTAL | 452 | 371 | 82 | 5268 | 570 | 11 |

Table 6:13

Peak Employment, Residents of the Province
FEP-MEDIUM

| Year | Drilling Crew | Marine Crew | Offshore Support | Onshore Operations | Seismic Operations | Total |
|---|---|---|---|---|---|---|
| 1981 | 288 | 415 | 286 | 145 | 55 | 1189 |
| 1982 | 336 | 481 | 330 | 189 | 55 | 1391 |
| 1983 | 258 | 370 | 249 | 168 | 74 | 1119 |
| 1984 | 310 | 437 | 294 | 211 | 80 | 1332 |
| 1985 | 258 | 373 | 249 | 201 | 80 | 1161 |
| 1986 | 222 | 315 | 213 | 190 | 100 | 1040 |
| 1987 | 222 | 318 | 213 | 157 | 100 | 1010 |
| 1988 | 277 | 399 | 266 | 168 | 86 | 1196 |
| 1989 | 296 | 404 | 266 | 168 | 86 | 1220 |
| 1990 | 236 | 319 | 211 | 157 | 65 | 988 |

Table 6:14

Peak Employment, Residents of the Province
LOW-MEDIUM

| Year | Drilling Crew | Marine Crew | Offshore Support | Onshore Operations | Seismic Operations | Total |
|---|---|---|---|---|---|---|
| 1981 | 432 | 628 | 433 | 176 | 93 | 1762 |
| 1982 | 480 | 694 | 477 | 253 | 93 | 1997 |
| 1983 | 621 | 853 | 573 | 307 | 111 | 2465 |
| 1984 | 725 | 987 | 661 | 328 | 120 | 2821 |
| 1985 | 725 | 1019 | 676 | 328 | 161 | 2909 |
| 1986 | 832 | 1105 | 728 | 372 | 181 | 3218 |
| 1987 | 721 | 972 | 639 | 351 | 181 | 2864 |
| 1988 | 777 | 1092 | 721 | 328 | 173 | 3091 |
| 1989 | 947 | 1252 | 816 | 349 | 173 | 3538 |
| 1990 | 947 | 1231 | 800 | 349 | 130 | 3457 |

Table 6:15

Peak Employment, Residents of the Province
LOW-HIGH

| Year | Drilling Crew | Marine Crew | Offshore Support | Onshore Operations | Seismic Operations | Total |
|---|---|---|---|---|---|---|
| 1981 | 432 | 628 | 433 | 176 | 93 | 1762 |
| 1982 | 517 | 694 | 477 | 253 | 93 | 2034 |
| 1983 | 621 | 914 | 612 | 307 | 120 | 2574 |
| 1984 | 777 | 1058 | 705 | 328 | 120 | 2988 |
| 1985 | 777 | 1105 | 721 | 328 | 173 | 3104 |
| 1986 | 888 | 1267 | 825 | 372 | 195 | 3547 |
| 1987 | 769 | 1123 | 725 | 351 | 209 | 3177 |
| 1988 | 880 | 1214 | 766 | 328 | 186 | 3374 |
| 1989 | 1006 | 1447 | 917 | 349 | 198 | 3917 |
| 1990 | 1065 | 1451 | 899 | 349 | 148 | 3912 |